MACHINERY.

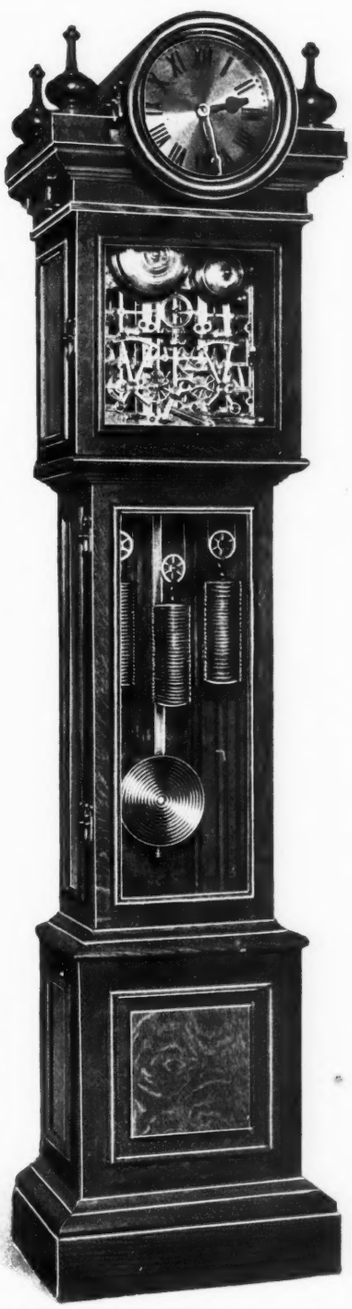
March, 1905.

A FIVE MINUTE REPEATER CLOCK.

JAMES ARTHUR.

James Arthur.

In MACHINERY for November, 1901, was presented a description of a Remontoir clock which attracted much attention, being republished several times in other journals. The clock here shown is also of the writer's design, though it might be well to state that this is not a part of the business of the Arthur Company, but merely a personal hobby and amusement of my own, and that no clocks are made for sale. This is the seventeenth complete clock which I have built, and I consider the design of cases in connection with the various styles of movement as of primary importance. In other words, the case and movement must harmonize so as to produce a perfect clock. Horology is, to my thinking, one of the most scientific amusements, since it implies some knowledge of mechanics, mathematics, and astronomy, as well as many minor sciences. One of the most important phases of the subject is the fact that the modern machine tool builder rarely acknowledges his indebtedness to the ancient clock and watchmaker; for the working and tempering of steel, hammering of brass, bearings, friction, oils, springs, gear, teeth, etc., had reached a high-pitch generation before the era of the modern tool builder. Take one example: Any smart young fellow knows that when it is necessary to drill a hole through a long piece, like a rifle barrel, the piece must rotate while the drill is held fast, and that the tendency of the drill is to follow the center line of rotation. Now the ancient clockmaker used the "drill and bow," but when he wished to drill a hole through a long piece, like the hub of a "cannon pinion," he caught the "long drill" in the vise and rotated the piece with the bow. The cannon pinion is so called because it has a long hub like a small cannon. Some of these days a book may be added to the numerous works on horology, showing the inventions and discoveries of the clockmaker side by side with modern mechanical practice. An exhaustive work of this kind would take most of the pride out of the present machine constructor.



The Arthur Five-minute Repeater Clock. This Clock strikes the hour automatically, and the hour and minutes—in multiples of five—any time between, when desired.

The general view of the five-minute repeater, taken from a photograph, shows the complete clock, the case being solid oak. What would usually be the face of the clock shows the movement in skeleton framework, and by opening the door the whole mechanism of the clock is as easily got at as if standing on the table. From this movement a vertical shaft goes up to operate the dial work. The dial is brass and has heavy gothic numerals and very distinct hands, which make the clock easily read, although the dial is only 9 inches in diameter. The left weight actuates the hour strike, the middle one the time, and the right-hand one the five-minute strike. The clock is called a "Five-Minute Repeater" because it will repeat the time to within five minutes as often as you pull the cord attached to it; but if let alone it is silent and simply shows the time by the dial and hands. The cord attached may be branched off and have an ordinary bell-pull at every bed in the house, so that any one can have the clock repeat the time during the night. On a deep-toned bell it strikes the last hour, followed on a high-toned bell by a blow for every five minutes past that hour. When it strikes the hour only, then you know that it is less than five minutes past. For instance, suppose it strikes "FIVE-five," then the last hour was five, and five times five minutes past, giving 5:25. But there is another way of considering the matter. The large bell gives the figure which the hour hand has passed, and the small bell the figure which the minute hand has passed, thus making a picture on your mind just as if you had looked at the face of the clock. This will be plain when you remember that in looking at a clock or watch you generally get a mental impression of the time for your own use. This is proved by the fact that if any one asks you for the time just after you have looked for yourself, you will look again and give hours and minutes.

JAMES ARTHUR, born in 1842, was trained in his father's shop to millwright work, machine work, patternmaking, etc., but when twenty-two he decided on a wider field and spent seven years in the Glasgow Locomotive Works, Scotland. In 1870-71 he took the course in mathematics, mechanics, light, heat and sound under Prof. A. S. Herschel in the "Science and Art Department" of the Andersonian University in Glasgow, Scotland. The professor is a son of Sir John and grandson of Sir William Herschel, the great astronomers. Mr. Arthur received a "Queen's prize" and also has the usual certificates of the department for the separate subjects, but values most highly several scientific books presented to him by the professor and inscribed in his handwriting. He came to the United States in 1871 and within a year was manager of the steam pump and machine works of Adam Carr, New York, and during his seven years there took out a number of patents, some of them jointly with Mr. Carr. In 1878 he branched off for himself and took a partner; then later a special partner, and finally in 1885 he purchased all interests and formed the present style: "The Arthur Co." machine works. This is one of successful "close corporations," and is wholly owned by Mr. Arthur and his two sons. He has generally confined his inventions and several machines to his own business, and is still active at 63 years.

It would be impracticable, in a reasonable space, to show all parts of this clock; therefore, bearings, supports, guides, brackets, etc., are left out in many cases, showing only the essential parts of the construction. In Fig. 2 *A* represents the framework of the movement, 11½ inches square, the front plate in three sections and cut out as shown. The back plate is a solid piece and has the nineteen pillars, *B*, etc., riveted in fast. The advantages of this style of framework in building and adjusting, and in future for cleaning and repairing, are evident, as the clock has a complete train of wheels for each section. The great wheels, *C*, all have barrels and ratchets as shown on the one to the left. Wire cords pass down to the three weights as shown. The center section is the "time train," and as numbers of teeth are marked, it requires no explanation, except that all calculations start from the axle marked *HOUR*, rotating in one hour, so we have $\frac{90 \times 96}{12 \times 12} = 60$ rotations of the scape wheel, shown in full black, per hour for the seconds dial. This hour wheel drives a pinion *D* of 15 teeth, so that *D* rotates in ten minutes. On this ten-minute axle is a 12-tooth pinion, driving a 60-tooth crown wheel *E* on the vertical shaft *F* which goes up to the head of the clock, and which by a pair of bevel wheels of 50 and 60 teeth gives the hour axle of the dial. That is, commencing with the hour wheel in the movement, we have $\frac{90 \times 12 \times 50}{15 \times 60 \times 60} =$ unity, or one hour, for the center axle in the head of the clock. Behind the dial the usual cluster gives the correct ratio to the hands. It will be seen that the vertical shaft *F* is broken by a crank at *G*, the lower half of which is slotted to take the upper half *G*. The lower part of this shaft *F* works in bearings in the frame and belongs to the movement of the clock, while the upper portion with its half-crank *G* belongs to the head of the clock, the cross bar *H* fastened to the case being its lower

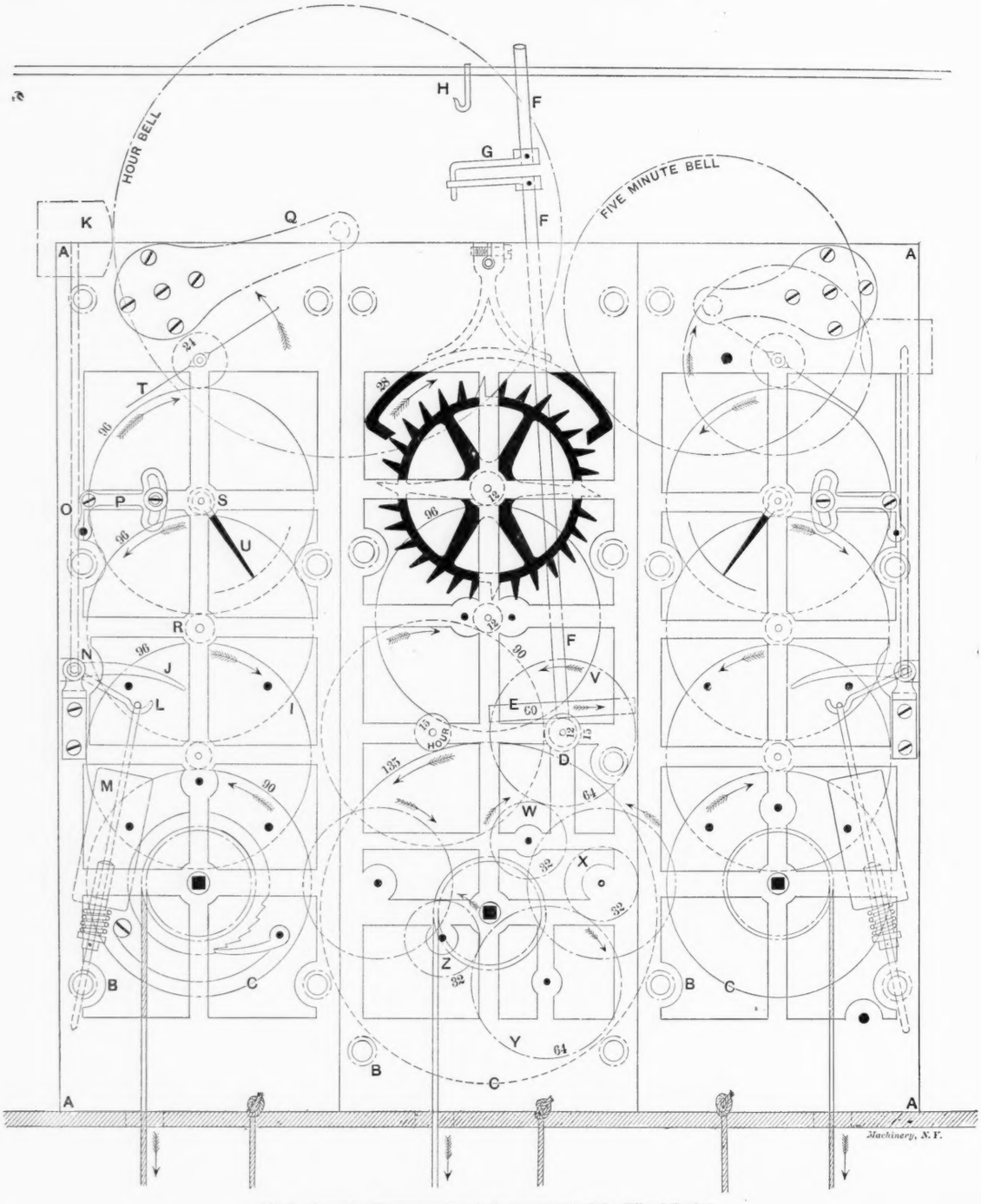


Fig 2. Showing Escapement and Arrangement of the Wheel Trains.

bearing. This portion of *F* slides easily upward so that half-crank *G* can be placed in the hook near *H*, thus making it as easy to lift the movement out of the case as if shaft *F* did not exist. Further, this break in *F* is an expansion joint as well as taking the variations in the case caused by damp or dry air, and is therefore a little thing of importance.

Where an open circle is shown as a center it generally means a bearing or pivot, but where a solid black center is shown it means a stud riveted or driven in solid. Looking to the left or hour striking train, it will be seen that wheel *I* has eight pins which lift the tail *J* and therefore the hammer *K*. The arm *L* as well as the hammer stem *O* and the tail cock or bracket *Q*, and is 6 inches diameter, 2 inches deep by ⅛ inch thick, and of bell metal; the five-minute bell is 4 inches diameter but otherwise the same, and has a high tone easily distinguished from the hour bell. The 96-tooth wheel *I* drives a pinion of 12 eight times, therefore *R* makes one turn for each blow struck. Axle *S* makes eight turns per blow, but this is not important so long as it makes some integral number per blow, as will become plain later in connection with arm *U*. The train ends in the fly *T* which regulates the speed of striking. Up to this point the train for the five-minute strike on the right side of the figure is the same as described for the hour, but this covers only the elementary

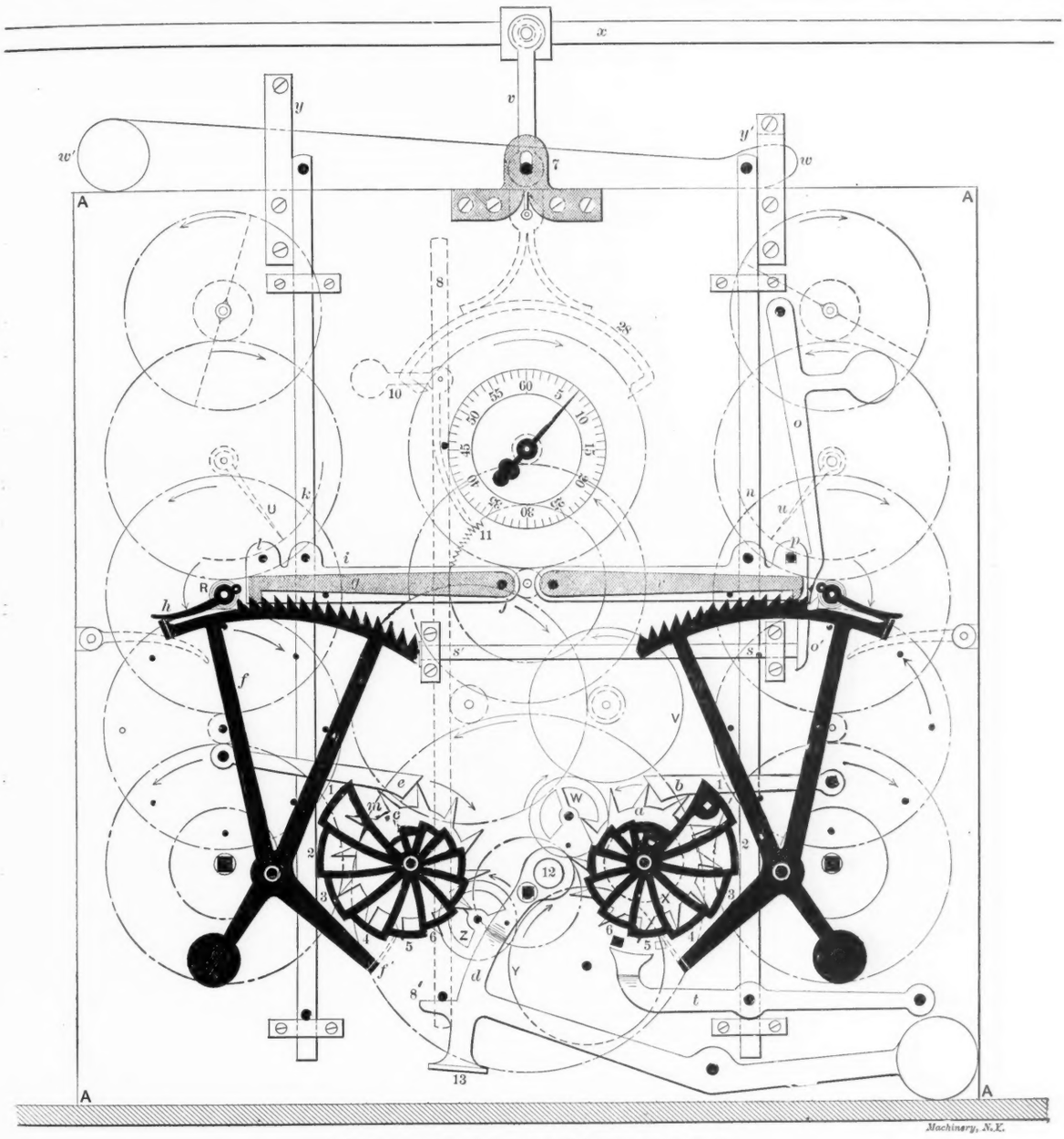


Fig. 3. Showing Snails, Wipers and Racks in Full Black.

J are all fast on the axle *N*, so that the weight *M* is lifted with the hammer and in its descent gives force to the hammer *K*. Under the weight *M* will be seen a helical spring forming a cushion to prevent the pounding of the weight at each blow. The stem of weight *M* is guided through a hole in one of the pillars *B* as shown. The stem of the hammer *O* is spring steel and banks against a pin in the adjustable bell crank *P*, so that it may be set for the most effective blow of the hammer. Note that the hammer does not touch the bell when at rest. As wheel *I* rotates, as per arrow, a blow will be struck on the hour bell as each of the eight pins lifts and passes the hammer tail *J*. The hour bell is supported on a part. If these two trains were wound up they would strike continuously till run down, but their regulation to match the time will be shown in the next figure. Wheels drawn in dash and dot lines, *V*, *W*, *X*, *Y*, *Z*, are all outside the framework, *V* being fast on the axle *D*, prolonged through the frame, and rotating in ten minutes as described above. *V* drives *W*, which is half its size and therefore is the five-minute wheel, mounted on a stud. This five-minute wheel *W* is important, being the starting point for all calculations, relating to the repeating or striking mechanism.

In Fig. 3 we have the same framework, *A*, but shown as a plain plate to avoid complication. The 12-tooth star wheel *a*,

the 32-tooth gear wheel *X*, and the 12-stepped snail in full black, are fastened together and rotate on the stud as one piece. As the five-minute wheel *W* has a crank pin, plainly shown, it will move star wheel *a* one tooth each five minutes, or one turn in an hour. The 32-tooth gear *x* is therefore a one-hour wheel. Wheel *X* drives another 32-tooth wheel *Z* through the intermediate *Y*, usually called an idler. Now we have a one-hour wheel *Z* driving the star wheel *c*, one tooth each hour, or one step of the left-hand snail per hour. The piece in full black, *f f'*, is called the rack. The wiper *h* is now set or stopped by the rack, which is bent up at a right angle just under *h*, the rack itself being held in its present position by the hook *g*. The lifting piece *i* and the hook *g* are centered on a stud *j* common to both. Hook *g* is lying on a banking pin or stop riveted solid in *i*, so that if we lift vertical bar *k* we lift *i* and *g* also, and the rack being free will fall outward to the left because of its counterweight, till its tail *f'* strikes the step of the snail marked 5, its path being shown by dotted lines. The proportions are such that just five teeth of the rack have fallen to the left from under the hook *g*, and as the wiper *h* is now free we might expect the clock to strike, but it has only prepared to strike—"given warning"—for in lifting the hook *g* out of the rack we brought the stud *l*, which projects inward, into the path of the arm *U*, and the clock is held till we drop *k*, when everything is free and the striking goes on. On the hub end of the wiper *h* will be seen a little crankpin which at each turn of the axle *R* moves one tooth of the rack under the hook *g*, acting as a one-tooth pinion. Now as five teeth of the rack fell over, on the fifth turn of wiper *h* it arrives just where shown in the drawing and the striking is stopped at five strokes, namely, 5 o'clock. The tail of the rack at *f'* is bent up at a right angle just as it is under *h*. It is easy to see that as often as *K* is lifted the clock will repeat 5 o'clock, but the little crankpin of the one-hour wheel *Z* will come around and at 6 o'clock register the next step of the snail, which would allow six teeth of the rack to fall past. The snail is numbered only up to 6 o'clock, and should be continued to 12, the lowest step, but this is left out to avoid confusion in the drawing. The position of this hour snail and its star wheel *c* is maintained by the piece *e* which lies between two teeth by its weight as shown. As hour wheel *Z* rotates, as per arrow, its crankpin will engage a tooth of the star wheel, and as it moves, the tooth just above *c* will lift the piece *e* till it reaches the lower corner, at which point *e* will descend by its weight, driving star wheel *c* forward and landing in space *m* when step 6 will come opposite the tail *f'* and the clock is in position to strike 6. Let it be carefully noted that while the jumper *e* is being lifted, the clock will still repeat 5 o'clock, but that during its fall or jump it drives the star wheel *c* ahead and it is this motion which brings the 6 o'clock step under the tail *f'*. That is, the change to the next hour takes place in the fraction of a second in all cases. This striking of the last hour and the fact that the clock will not anticipate the coming hour by even one second must be kept in mind to understand the five-minute mechanism now to be explained.

We are now ready to consider the right or five-minute part of the movement. All that has been said about the hour side is equally applicable to the five-minute side, and to make this easier the drawing is made to show the position of five blows on the right side, too. It therefore follows that if lifting bar *n* is pulled up, the rack will fall past five teeth preparatory to striking five blows. But on lifting *n* the hook *o o'* will fall in under the pin *p* and hold this side up, locking it so that *n* will not drop and the hook *r* will remain up, and pin *p* will stop arm *u* and hold the clock from striking. A cross slide *s s'* touches the lower end of hook at *o'*, the left end touching the hour rack. Now let us lift bars *k* and *n* together and let go, then *k* will fall and the hour will be struck, but *n* will be locked till the last blow of the hour brings the rack against cross slide at *s'*, thus pushing out the hook *o o'* and discharging or letting off the five-minute side, which in the position of the right-hand snail will strike five blows, giving 5.25. The five-minute wheel *W* and its crankpin will register star wheel *a* and five-minute snail on the first second of each five minutes, the jumper *b* acting just as *e* does for the hour side on the left. On the twelfth registration of wheel *a* and its snail the crankpin of one-hour wheel *Z* has come around, and on the even hour both snails register together, *b* and *e* jumping as nearly together as the eye can detect. But there is a slight difference, in fact, for *b* is adjusted to commence falling a very little ahead, to make sure that the hour could not register first, though practically they are simultaneous. According to the description so far, when the clock registers for the hour it would also register for twelve times five minutes, which would be a confusion and an absurdity, since only the hour ought to be struck till five minutes past has been reached. In other words, when the five-minute snail comes to that part of its motion which would strike twelve it must be prevented from doing so, as only the hour strike is wanted at that time. By looking at the highest step of the snail, marked 1, a square stud will be seen. This stud on the registration of the hour comes into the position shown by a solid black square near the figure 6, and gets into the range of the lever *t* which is connected to lifting bar *n* as shown, and prevents *n*, and therefore hook *r*, from being lifted, so the five-minute side is silent and only the hour is struck. At five minutes past, this stud has jumped to the position shown by the open square just to the right of the figure 5, out of the way of lever *t*, and the clock is ready to repeat the hour and five minutes past. This repeating mechanism must be mounted delicately, and therefore a vigorous tug on the cord which lifts *n* would do harm when lever *t* comes against the stud on the snail. Provision for a little rough handling of the cord is made thus: The lifting bars *k n* are pulled up by lever *w w'* through the link *v* connected to a crank on the shaft *x* which runs across the head of the clock and has an arm outside for attaching the cord. This lever *w w'* is overbalanced a little at end *w'* as shown; end *w* therefore lifts first up against the stop *yy'*, then the pin in lower end of link *v* comes up against the upper end of the slot in the bracket 7, so that lever *w w'* lifts the same at both ends, bringing up *k* and *n* alike. Now suppose the stud is in position as shown near 6, then end of lever at *w* is held down by lever *t*, but the pin in link *v* strikes the top of slot of 7 just the same, the lever at *y* rising twice as far, which does no harm. In both cases the important stop is the bracket 7 which is made extra strong, and a little consideration will show that no matter how hard you pull the cord the extra force is taken by 7, and the square stud in the snail can never receive more pressure than the slight overbalancing at

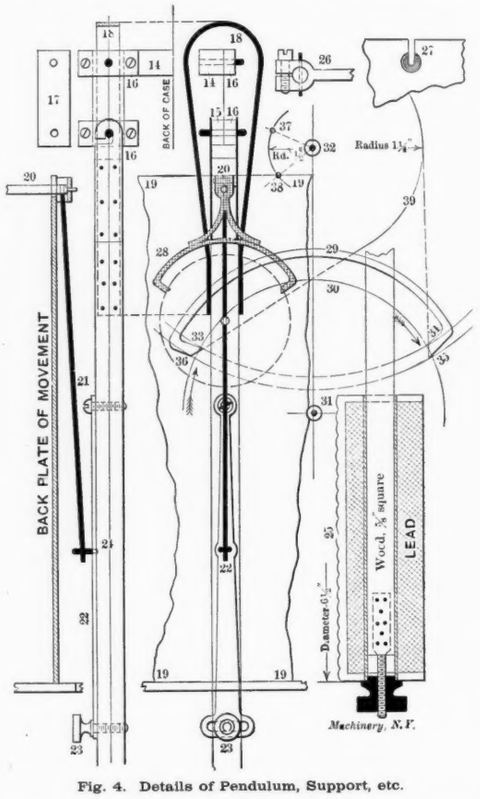


Fig. 4. Details of Pendulum, Support, etc.

the end of the lever w'. A vertical bar inside the movement is shown at 8 8'. This bar carries a click 10 which in its present position just clears a fine-tooth ratchet wheel, 11, on the axle of the second wheel. This bar and its click or ratchet are held up by a weighted lever d catching a stud at 8'. It will be seen that this lever covers the winding square of the time train, but by pushing down its end, turned out like a step at 13, the winding key can be introduced, as opening 12 comes opposite the winding square. But while the key is in use bar 8 8' has lost its support under stud 8' and its ratchet 10 catches the wheel 11 and drives the clock during the time of winding. On withdrawing the key the parts assume the position shown on the drawing. Ratchet 10 does not touch wheel 11 except when in use during winding, so there is no drag or disturbance of the clock. Springs have been almost left out of this clock, as experiments I have made have shown that gravity is far superior, especially where a uniform action is necessary, as in the blow of the hammer, the jumpers e b, the sustaining power 8 8', and the rack f f'. The wheels W and Z have heavy sides where the crankpins are placed. These wheels operate on the star wheels for about a minute and at the hour they operate together, so the time train must be overweighted enough to do this work and this is always objectionable. An attempt is made here to reduce that evil by making the heavy side of W about equal to half the force, consequently half the force comes on the wheel W

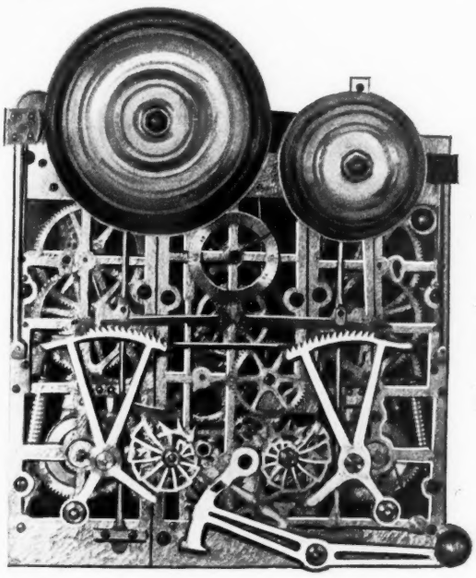


Fig. 5. Front View of Works out of Case.

twice in five minutes. If the wheel W were balanced, then the whole force necessary to move star wheel a would come on once in five minutes. The wheel Z is treated in the same way, but since during the last minute of each hour both W and Z act together, an attempt has also been made to lessen that difficulty, the right-hand snail having a heavy side so placed that it assists at this critical moment, and thus divides this pull into half-hourly parts. The left-hand, or hour snail is, for evident reasons, balanced.

In clock trains where the wheels drive pinions it is always desirable to do the driving after passing the line of centers, and high-class clock wheels are always cut so that the wheels drive by their faces acting on the flanks of the pinions. As this clock is cut with involute cutters, as used for general gear cutting, a similar result is produced as follows: Wheels are sized as usual, but cut five per cent deeper than standard, giving a rather thinner tooth. The pinions are sized one-half diametral pitch smaller than standard. That is, to their pitch diameter is added only 1½ diametral pitch, and they are cut standard depth. Thus in both wheels and pinions the teeth are a little thinner than usual and give the necessary freedom for clockwork, as perfectly fitting gears would be easily stopped by dust or sticky oil. On the other hand, this freedom or back-lash does no harm, since clock gears drive slowly and steadily in one direction. Finally this undersizing of the pinions, which is really making them of a smaller pitch than the wheels, gives an easy entrance and brings the principal pressure of driving during delivery after passing the line centers.

Fig. 4 gives some details. 14 is a heavy stud, solid in a plate going across the back of the case. In this stud and also in piece 15, pins ⅛ inch in diameter, shown in black, are driven fast. The clamping pieces, 16, are alike and clamp the spring at both ends. The spring is ¾ inch wide and .008 inch thick and is 1 inch free between clamps. Clamps 16 are an easy fit for the pins. The spring is of the simplest form and is shown at 17. The pendulum rod is ⅝ inch square wood and has steel cheek pieces riveted on, forming a double hook as shown. A safety loop 18 is also riveted to the pendulum rod, so that should the spring break at any time in future this loop would drop on stud 14 and the pendulum would be saved from falling to the bottom of the case. A portion of the clock frame in relative position is shown at 19, so it is easy to see that the pendulum is suspended very much higher above the pallet staff, 20, than is usual. The crutch, 21, is a straight spring wire and passes freely between two studs fast in the sector, 22. The crutch is adjusted as near the center of the movement as possible, but after the clock is set up plumb a final adjustment to get a uniform beat is easily made by the thumb nut 23. As 24 is the center line of suspension for the pendulum, it is seen that the crutch acts on the two studs ⅝ inch in front of said center line, but no twisting action can be detected owing, no doubt, to the wide spring and the heavy pendulum. The action is so satisfactory that this method is preferable to the usual plan of bending out the lower end of the crutch, 21, so as to act in the center line, 24. So long as the pendulum does not show any twist in its swing it may be assumed that the direct action of the crutch straight from the axle or staff 20 is all gain. The bob of the pendulum, 25, is 6½ inches diameter, 2 inches thick and weighs 26 pounds. It is a brass dish with a ⅝ inch square tube put through it and then filled with lead. The face is covered with concentric beads of a flat curve as shown in section, so that it blazes with reflected light at almost any angle of view, and has a very live appearance. The bottom screw and nut are plain enough at sight. At 26 is shown an enlarged view of a clamp hub, freely used in the clock, which can be adjusted and tested easily, and finally pinned, making it practically solid metal, and yet it can be taken off easier than a plain pinned hub. The one on the anchor at 20 is not pinned as it is subject to future adjustment in repairing the clock.

The wire cords of the clock are knotted on the free end and dropped into the recess shown enlarged at 27, so when they are adjusted to length and their ends knotted they need not be disturbed while they last. This simple moving of the knotted ends of the cords and the hooking up of the vertical shaft in the head of the clock enables the movement to be lifted out of the case much easier than in the usual clock of commerce. In the three figures the anchor, 28, is drawn for convenience as a dead beat, but it has a little recoil and is drawn to double size at 29 for the benefit of any one who might wish to lay out an escapement of this kind. Portion of circle 30 represents a 3-inch scape wheel, 31 being its shaft. 32 is the pallet staff or shaft of the anchor 29, and these are 3 inches distance of centers. The sector of a circle, 33-34, cuts scape wheel 30 in two points 120 degrees apart, or one-third of the scape wheel's circumference. Circle 35-36 is ⅛ inch greater in radius than this. Between these circles lie the impulse faces of the pallets, their angles being determined by the tangents to the circle 39 as plainly shown. The left-hand pallet is drawn from the center 37, and the right-hand one from the center 38. The result is that acting surfaces 36 and 34 give a little recoil to the scape wheel. If the pallets were laid out from center 32 and therefore lying between circles 33-34 and 35-36 the escapement would be a dead beat, but experiments have shown that a construction of about the proportions shown, in which the left pallet leans inward and the right pallet leans outward, gives steadier timekeeping. This form, which gives a slight recoil, is sometimes called the half-dead escapement. Finally, it is well to remember that there is nothing imperative in these proportions, for makers differ about them; but the above proportions have been found very good for a brass scape wheel and steel pallets, as in this clock.

MORE NOTES ON BAND BRAKE DESIGN.

C. F. BLAKE.

In the issue of MACHINERY for January, 1901 the writer gave formulas and a convenient chart for the solution of the holding power and tensions in the brake band. The chart was also reproduced in one of the data sheets of March, 1903. The formulas and chart then given applied to flat-faced brake wheels only, and since the V-grooved brake wheel is often met with, we must find the increased holding power due to the wedging of the blocks into the V-groove.

Referring to Fig. 1, let N = the normal pressure on a flat-faced wheel, n = the normal pressure on one side of a V-grooved wheel, $2n$ = the total normal pressure on a V-grooved wheel.

Let $b\text{-}c = \frac{N}{2}$ for a flat wheel of diameter D, which is the mean diameter of the V-grooved wheel.

Then $b\text{-}d = n$, and $\sin.a = \frac{\frac{N}{2}}{n} = \frac{N}{2n}$

and

$$n = \frac{N}{2 \sin. a}.$$

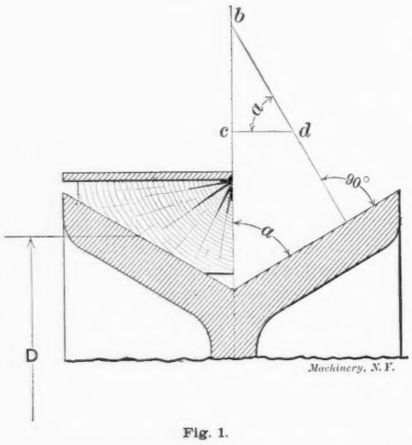


Fig. 1.

Since the pressure n is exerted on each side, we have

$$2n = \frac{N}{\sin. a}.$$

The tangential force P for a flat face $= N\,\mu$, and for a V-grooved face the tangential force $P_1 = 2n = \frac{N\,\mu}{\sin. a}$. Then

$$\frac{P_1}{P} = \frac{\frac{N\,\mu}{\sin. a}}{N\,\mu} = \frac{1}{\sin. a} = \text{cosec. a.}$$

and

$$P_1 = P \text{ cosec. a.}$$

The following table gives the values of the cosecants of various angles, for use in the above formula:

Angle a Degrees.	Cosec.	Angle a Degrees.	Cosec.	Angle a Degrees.	Cosec.
15	3.86	46	1.39	80	1.015
16	3.63	48	1.35	82	1.009
18	3.24	50	1.31	84	1.0055
20	2.92	52	1.27	86	1.0024
22	2.67	54	1.24	88	1.0006
24	2.46	56	1.21	90*	1.0000
26	2.28	58	1.18		
28	2.13	60	1.15		
30	2.00	62	1.13		
32	1.89	64	1.11		
34	1.79	66	1.09		
36	1.70	68	1.08		
38	1.62	70	1.06		
40	1.56	72	1.05		
42	1.49	74	1.04		
44	1.44	76	1.03		
45	1.41	78	1.02		

* Flat face.

Fig. 2 represents various forms of band brakes. At A the fixed end, T_2 is passed through the loose end, T_1, securing a large arc of contact. At B the fixed end is also passed through the loose end, and is fastened to the shaft or pin of the operating lever. C is the so-called differential brake. The arms, e and c are made in inverse proportion to T_1 and T_2. Thus we have,

$$\frac{T_1}{T_2} = \frac{c}{e},\ T_1\, e = T_2\, c$$

And since $T_2 = k\ T_1$, we have $e = kc$.

Substituting these values we have,

$$T_1\, kc = kT_1\, c.$$

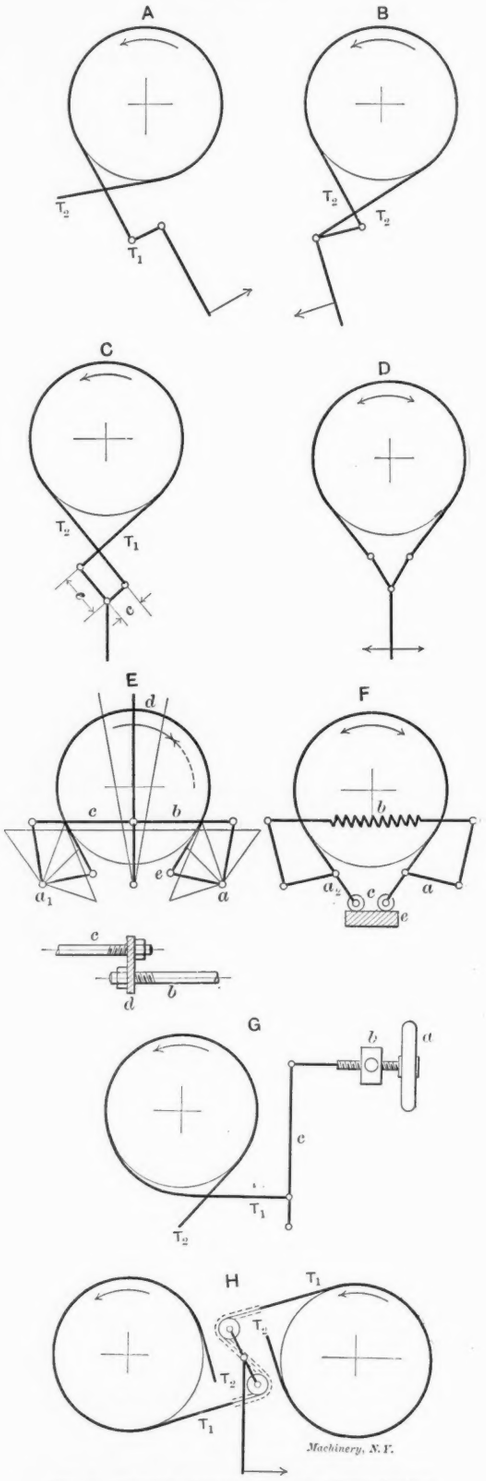


Fig. 2. Showing Various Forms of Band Brakes.

Thus it requires very little force to apply the brake, making a brake, indeed, too sensitive for frequent use on cranes.

D is a form of brake that is used where the brake must be applied with the brake wheel running in either direction. This form is only applicable to light loads, since there is no fixed

end and the brake cannot be made on the differential principle for each direction of rotation.

E represents a form of brake to be used with a wheel rotating in either direction, and having a fixed end for each direction of rotation. The ends of the strap are fixed to bell cranks, a_1 and a, which bell cranks are attached to the operating lever d, by links, c and b. Let the wheel be supposed to be turning in the direction of the dotted arrow when the brake is to be applied. Moving the lever d toward the dotted position we pull on the link, c, while sliding freely on the link, b, and thus we pull bell crank, a_1, toward the dotted position while bell crank a will move toward the dotted position under the influence of the friction of the band on the revolving wheel. The position of the bell cranks is made such that the end e of crank a will come in contact with the rim of the wheel upon very slight movement of the crank, thus forming a fixed end for the strap, the arm *e-a* forming a strut between the rim of the wheel and the point a. The reverse of this action will take place when the wheel is revolving in the direction of the full-line arrow.

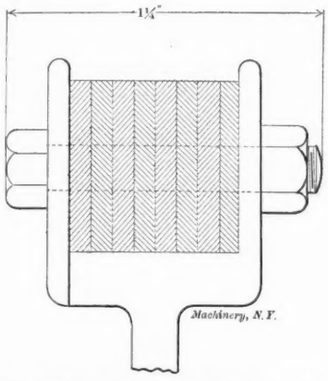


Fig. 3. Brake Wheel with Friction Member in the Wheel.

F is an application of the same mechanism to a solenoid brake for electric cranes. The tension upon the band is produced by a spring, b, and the brake is released by the lever e being raised against the rollers on the bell cranks by the solenoid.

G is a very powerful form of brake employed for heavy loads. It is operated by a handwheel on a screw turning in a pivoted nut, b. The screw and band are attached to a lever, as shown.

H is a form of brake applicable to two brake wheels, useful in confined spaces. The band is continuous, embracing both wheels, the central portion between the wheels being flexible, (conveniently of chain), passed over rollers on the arms of a bell crank. The operation is evident from the sketch, the rollers and chain forming an equalizing device to compensate for uneven wear of the bands upon the two wheels, or a difference in adjustment.

Fig. 3 shows an excellent form of wheel in which the friction member is in the wheel instead of being a lining for the band. The rim is made with a loose flange, and thin strips of wood, fiber, leather or paper, are clamped between the flanges. The encircling band may then be steel without a lining.

Example: A band brake is required to hold 136,160 inch-pounds torque; wheel to be V-grooved, 120 degrees, $a = 60$ degrees; holding power $= 1.15 \times$ holding power of flat band, mean radius of wheel being 18 inches.

Required torque flat band should hold $= \dfrac{136{,}160}{1.15} = 118{,}400$ inch-pounds.

$\dfrac{118400}{18} = 6577$ pounds tangential force necessary.

Arc of contact being 270 degrees, coefficient of friction $= .3$, $k = 4.11$.

$P = T_1 (k - 1)$

$6577 = 3.11\ T_1$

$T_1 = 2115$ pounds pull necessary in loose end of band.

$T_2 = 2115 \times 4.11 = 8692$ pounds pull in fixed end of band.

$P = T_2 - T_1 = 8692 - 2115 = 6577$ pounds (check).

The Clam Shell Brake.

The type of brake known as the clam shell, Fig. 4, is often used in place of the band brake. The cast arms, *H*, are pivoted at *A* on the frame of the machine, and carry blocks *K* formed to grip the brake wheel. Links *BE* and *CD* connect the arms *H* to bell crank *DEFG*, pivoted to the frame at *F*.

From *A* draw lines through the center points of contact at a, a', on the rim of the wheel; also from *A* as center draw circle *e-e-e*, cutting these lines at *B* and *C*. At these points draw tangents *BE* and *CD* to the circle *e-e*. Draw circle *n-n-n* tangent to *BE* and *CD*. The radii of circles *e-e* and *n-n* are chosen to give the required leverage to the brake system, and we have

$$ca = \frac{P \times GF \times CA}{FD \times Aa}$$

and,

$$c'a' = \frac{P \times GF \times BA}{FE \times Aa'}$$

By the method of construction we have,

$$CA = BA,\ FD = FE, \text{ and } Aa = Aa',$$

therefore

$$ca = c'a'.$$

The force ca resolves into components ab and bc, and since from the theory of similar triangles we have angle $cab =$ half the angle y,

$$ab = ca \times \cos.\ \frac{y}{2}$$

also,

$$a'b' = c'a' \times \cos.\ \frac{y}{2} = ca \times \cos.\ \frac{y}{2}$$

The forces ab and $a'b'$ multiplied by the coefficient of friction f, form a couple tending to retard the rotation of the wheel, and we have for the torque absorbed by the brake,

$$ab \times f \times aa' = (ca \times \cos.\ \frac{y}{2})\ (f \times aa') \ldots\ldots\ldots (1)$$

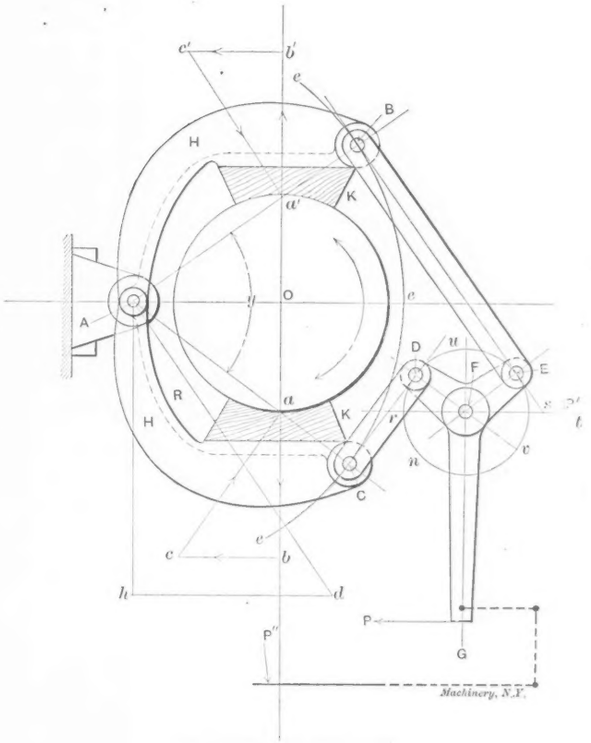


Fig. 4. The Clam Shell Brake.

The forces *bc and b' c'* are transferred to *A*; also we have on *A* a force $2ab \times f$, the direction of which is determined by the direction of rotation of the brake wheel.

Supposing the wheel to be turning in the direction of the full-line arrow in the sketch, we should then have upon *A* the two forces $Ah = 2ab \times f$, and $hd = cb + c'b' = 2cb$, and resolving these we find $R, = Ad$, as the resultant pressure on *A*.

Example: Suppose the system of leverage such that

$$ca = c'a' = 1000 \text{ pounds},$$

Let $y = 66$ degrees, then $\cos. \frac{y}{2} = 0.838$,

$f = 0.3$, diameter of the brake wheel $= 20$ inches.

From (1),

$T = (1000 \times 0.838)\ (0.3 \times 20) = 5028$ inch-pounds.

The figure shows no device for adjustment for wear. This is accomplished in many ways, but should always be of the nature of an equalizing device. This bars out putting adjustment into links *BE* and *CD*, as is sometimes done, it being impossible to adjust the two blocks evenly by this method.

The point *F* may be made a floating center, which then automatically adjusts evenly for wear. This is often done, replacing the double bell crank *DEFG* by a single lever, *rst*; although it is not good practice, since the load at *r* is $p = \frac{P\ (t\,s)}{r\,s}$, and at *s* is $P + p$, resulting in an uneven pressure on the blocks, the upper receiving the greater pressure by an amount $P + 2\ W$, if *W* is that portion of the weight of the arms and links supported at *a'*.

At *B* is shown a good type of brake, the feature being that both arms act as tension members in transferring the braking force to the fixed points *c*.

At *C* is a brake set with a toggle composed of two bent levers, *a b d*, fixed at *d*; the points *a*, being forced apart, press down on the upper arm *E*, and pull up on the lower arm *E* by means of the rod *e n*. The toggle forms an equalizing device, so that only one adjustment is necessary.

* * *

IMPULSE AND REACTION TURBINES.

A question frequently asked by those studying the steam turbine is "What is the distinction between the impulse and the reaction turbine?" Both water and steam turbines are grouped into two general classes known as impulse and reaction turbines, and to make clear the distinction between the two types, it will be necessary first to give an explanation of the terms "impulse" and "reaction."

Meaning of Impulse and Reaction.

A reaction is a force acting in a backward direction. According to older writers in mechanics, an impulse is a force acting in a forward direction. Strictly speaking, this is not correct. An impulse is not a force in the sense of being a push or a pull, but is a term used to express the same meaning as momentum, when the force acts for a very short space of time, as when one body gives another a sharp blow. When we speak of an impulse turbine, the older meaning of the term is usually implied to distinguish it from a reaction turbine; but it would be more consistent to speak of the two types as action and reaction turbines, as in fact is sometimes done. Even these terms, however, would be somewhat misleading, because all practical turbines operate both by the action and reaction of the working fluid, and it would be better to designate the two classes in some other way.

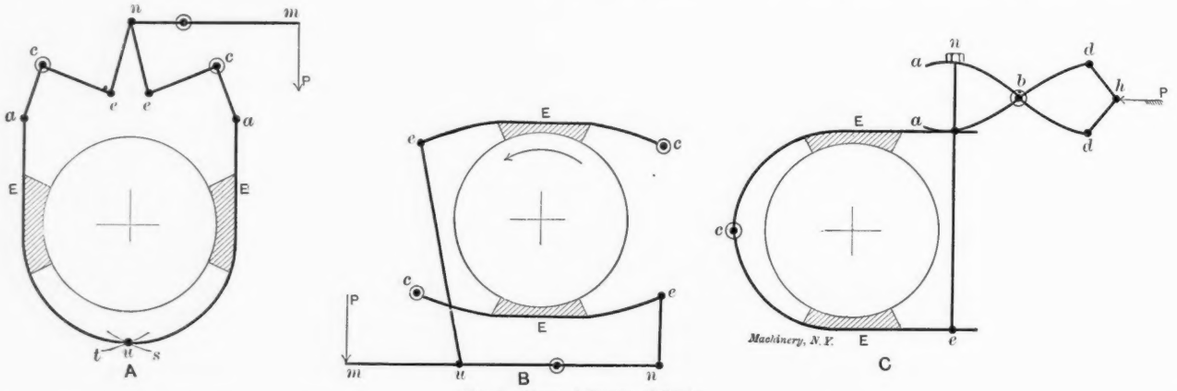


Fig. 5. Several Types of Brake.

A better method of making *F* a floating point is to keep bell-crank *DEFG* and attach thereto another bell-crank by a link, as shown in dotted lines. Where there is room to place this construction beneath the brake as shown, or to put a bent lever, *DE*, upon a shaft, *F*, and off to one side to place a lever, *FG*, attached to the link and bell-crank, this makes an excellent arrangement and equalizes all pressures upon the blocks except that due to the weight of the parts.

The point *A* may be placed below the wheel, making the axis *a a'* horizontal, with *F* a floating point, the arms *H* falling apart by gravity when released; and when the arms are not heavy enough to do this without having one of them bear against the wheel while the other is free, light springs may be attached to points *B* and *C*, to keep them apart when released.

The arms are sometimes extended so that points *B* and *C* may be connected by a spring which sets the brake, the release being made by levers separating the arms when applied. The wheels of these brakes may be made V-shaped, as explained for band brakes, and the same formula and table for the increased braking power applies. The blocks *K* are often made to embrace a larger portion of the wheel than shown, sometimes nearly 180 degrees. Types of this brake are often seen on electric cranes in connection with solenoid operating devices.

Fig. 5 shows several types of this brake, the fixed points being shown by a dot within a circle and the floating points by a heavy dot. *A* is a brake useful when there is no convenient way of pivoting the arms to the frame at *u*. The bell-cranks *a c e* and lever *m n* are pivoted as shown, but the point *u* is fixed in space only by its geometrical relations to points *a*. Since the arcs *s* and *t*, struck from the points *a*, cross at *u*, it is evident that the point *u* becomes fixed in relation to points *c* where the system is connected to the frame, and thus *u* is the fulcrum of the arms *E*, although not the point which receives the thrust of the brake arms, this being taken at points *c*.

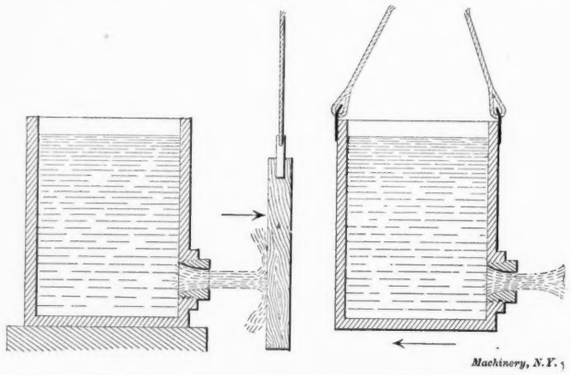


Fig. 1. Fig. 2.

In Fig. 1 is a tank from which water issues through a nozzle and impinges against a flat surface capable of moving horizontally—in this case the face of a plank suspended so that it is free to swing. When the water strikes the plank the latter will swing to the right under the pressure due to the impulse of the jet. As the jet leaves the nozzle, however, it exerts a reaction or backward kick against the tank, which is equal and opposite to the force due to the impulse of the jet. This

may be illustrated by suspending the tank, as in Fig. 2, so that it is free to swing, when it will move to the left, owing to the reaction of the jet.

The explanation of the reaction is that there is no pressure on that part of the tank where the nozzle is situated and the unbalanced pressure on that part directly opposite to the nozzle will therefore tend to move the tank in a direction opposite to that in which the water is escaping. The faster the water escapes, the greater the pressure required in the tank to give the water its velocity; and hence the greater the unbalanced pressure which we call the reaction. It is on this principle that a gun "kicks." If a blank cartridge is fired, the pressure due to the burning powder acts one way against the bottom of the barrel and the other way against the air and the former pressure produces the reaction. If the gun is loaded with a bullet it requires a higher pressure in the barrel to start the bullet on its course, and the reaction or kick is greater. Assuming the bullet to absorb all the energy of the charge, the momentum of the bullet would be equal to

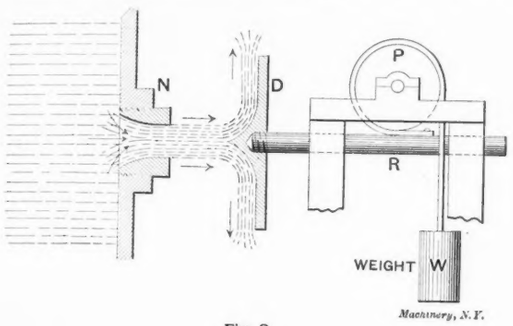


Fig. 3.

the momentum of the gun at the time of firing; but the gun, being many times heavier, would fortunately have much less velocity.

Impulse and Reaction upon Curved Vanes.

In Fig. 1 the velocity of the jet is suddenly checked when it strikes the plank, and there is more or less commotion of the particles of the fluid, causing loss of energy. This is always the case when there is impact of particles against a surface and is to be avoided by using a curved surface so placed as to change the direction of flow gradually without shock or jar. Such an arrangement is shown in Fig. 3, where a nozzle *N* is discharging against a plate *D* attached to the rod *R*. The rod is supported by guides and together with the plate can move longitudinally. The pressure of the jet against the plate is balanced by the weight *W* supported by a cord passing around the pulley *P* and attached to the rod *R*. The plate *D* is so shaped at the center as to gradually guide

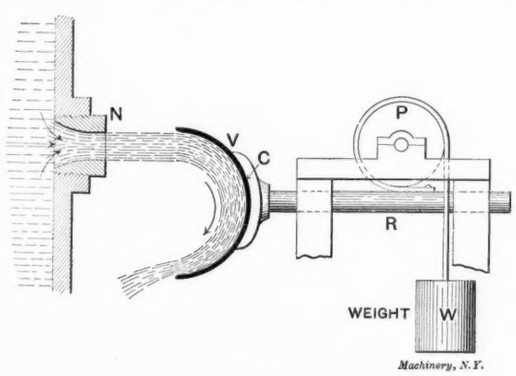


Fig. 4.

the particles of water through an angle of 90 degrees, thus avoiding the impact present in Fig. 1, and the particles leave the plate in a direction parallel with its face. It is evident that the pressure against the plate is due solely to the impulse of the jet and that the reaction of the water in leaving the plate has no tendency to move the plate longitudinally.

In Fig. 4, however, the case is different. Here the water strikes a curved surface and is turned back upon itself through an angle of 180 degrees. This surface is therefore acted upon by two forces, both tending to move it to the right. The first is that due to the impulse of the jet, just as in Fig. 3, which acts until the central point *C* of the curved surface is reached; and the second is the reaction of the jet, which begins where the jet starts to flow backward and continues up to the edge where it discharges. Both of these forces would be equal if there were no frictional or other losses, and it would require a weight, *W*, just twice as heavy as the weight in the first example to balance the end thrust.

Impulse Turbines.

All turbines known as impulse steam turbines, like the De Laval, for instance, operate on the principle of Fig. 4. The

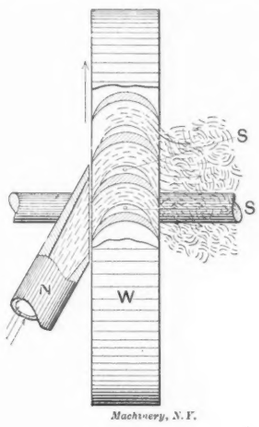


Fig. 5.

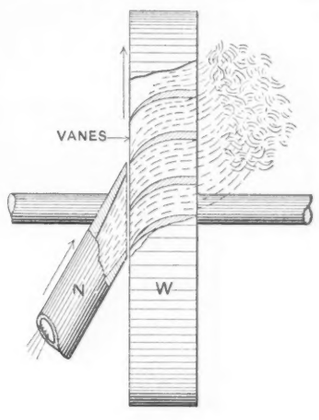


Fig. 6.

turbine wheel has curved vanes, as in Fig. 5, against which the jet of steam impinges. The expansion of the steam is completed within the nozzle, and there is no expansion in passing through the wheel passages. The pressure between the vanes is the same as the pressure within the casing in which the wheel runs, and the steam flows freely through the wheel passages in virtue of the momentum given it in the nozzle. The wheel is driven ahead, first by the pressure due to the impulse of the steam and then, after the vanes have reversed the direction of flow, by the reaction of the steam.

In Fig. 5 *N* is the nozzle, which may or may not be a diverging nozzle, according to the pressure against which it is

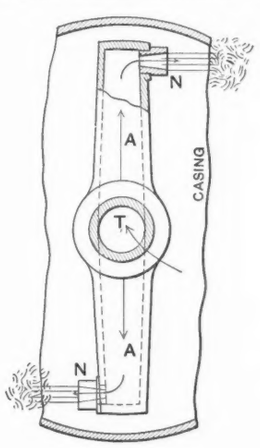


Fig. 7.

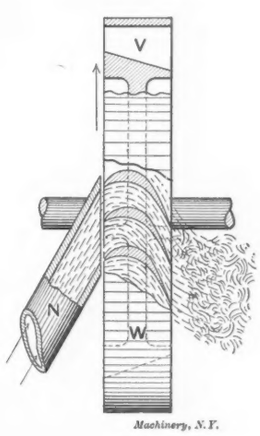


Fig. 8.

discharging, and *W* is the wheel. With the vanes constructed as shown, there would be spaces *S S* not filled by the steam, since the area of the passages at these points is greater than at the entrance and exit. Some manufacturers, however, make the blades thicker at the center than near the edges, to maintain a constant area and so avoid possible eddy currents. Although a so-called impulse wheel, it will be evident that this wheel acts both by impulse and reaction. The chief characteristic of this type is that the expansion occurs wholly in the nozzle or guide passages, as the case may be, and the steam flows freely through the wheel in virtue of its momentum, without expanding or acquiring additional velocity in the wheel passages.

What would strictly be an impulse wheel is shown in Fig. 6, where the vanes are so curved that when the wheel is held stationary the steam leaves them in a direction parallel with the shaft. The wheel is therefore propelled solely by the pressure against the vanes due to the impulse of the steam, and would be inefficient because the steam would have a high residual velocity when it left the wheel. Such a wheel is on the principle of the stationary vane in Fig. 3, against which the water exerted only half the pressure that it did when the force of reaction was taken advantage of.

Reaction Turbines.

In Fig. 7 is the simplest type of reaction wheel. Here the steam enters the trunnion *T*, flowing radially outward through the two hollow arms *A A*, until it discharges through the nozzles *N N*. The arms therefore rotate in a direction opposite to that in which the steam escapes, and are driven entirely by the reaction of the steam. The chief difficulty of this type of wheel is the excessively high speed of rotation. Supposing the wheel to be perfectly free to move, its momentum would be equal to the momentum of the escaping steam. The velocity of the arms therefore would be less than the velocity of the steam only in so far as the mass of the arms was greater than that of the steam.

In Fig. 8 is shown a more practicable form of reaction wheel. Here there is first the impact of the steam against the buckets, but the expansion in the nozzle is only partial and the steam expands still more and acquires additional velocity in flowing through the wheel, provision being made for this, if necessary, by having the passages diverge in the direction of the flow, as at *V*. The steam therefore reacts upon the wheel when it leaves the vanes as a result of the energy acquired in the wheel itself, and this feature gives it the name of a reaction wheel. It will be seen that the wheel acts both by the impulse and the reaction of the steam just as in the case of the impulse wheel. The distinction between the two, however, is that in the impulse wheel the expansion of the steam is complete within the nozzle and in the reaction wheel it is not completed until after it enters the wheel passage. If it were possible to attach a steam gage to one of the spaces between two wheel vanes, it would show a pressure equal to the pressure of the medium in which the wheel was turning in the case of the impulse turbine, and a pressure higher than that of the surrounding medium in the case of the reaction turbine.

* * *

VARIABLE SPEED MOTORS.—10.

THE H. WARD LEONARD CONTROLLERS.

WM. BAXTER, JR.

The H. Ward Leonard Company make a number of designs of controllers for variable-speed motors. Some of these are arranged to vary the velocity by means of armature resistance, and are not designed for use in connection with machine tools. The controllers intended for this latter service are arranged to vary the speed by means of field regulation.

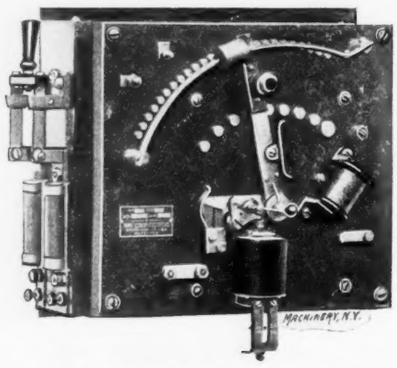


Fig. 1. Standard Type of Controller.

The standard controller of this type is shown in Fig. 1, and as will be seen is very simple, being in fact a modification of the standard Ward Leonard automatic motor starter, the modification being such as will enable it to vary the resistance included in the motor field circuit.

As will be seen in Fig. 1 the controller is provided with a side panel on which are mounted a two-pole main switch to connect the motor circuit with the main line, and a pair of safety fuses to protect the motor from excessive currents. The controller proper is provided with a circuit breaker, seen at the bottom of the slate front, so that the motor has double protection. The circuit breaker will respond to instantaneous rushes of current strong enough to energize the magnet to the active point, while the fuses will respond to weaker currents of greater duration. By adjusting these two protective devices properly, the safety of the motor is fully insured. The circuit breaker is adjusted so as to respond to a current strength considerably greater than that required to melt the fuses and will act whenever there is a sudden rush of current which, on account of its short duration, would not heat the fuses. The latter will come into action with a considerably weaker current than is required to actuate the circuit breaker, provided it continues for any length of time.

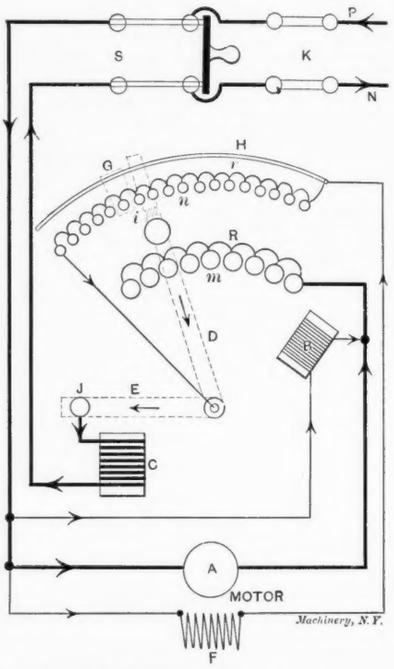


Fig. 2. Diagram of Controller, showing Circuit Connections.

The circuit breaker protects the motor from sudden rushes of current, not only when it is running but also in the act of starting. Thus, if an attempt is made to start the motor when it is overloaded, or if the operator advances the starting lever too rapidly, so as to cut out the starting resistance faster than the armature c. e. m. f. builds up, the circuit breaker will be actuated and thereby compel the operator to make a new start. If after two or three attempts carefully made, the circuit breaker still persists in acting, it is an indication that the load on the motor is more than it should carry.

The retaining magnet located at the right side of the controller will hold the operating switch in the running position, that is, with all the armature resistance cut out, so long as current flows through the motor. To make this action sure, with a motor in which the speed is varied by introducing resistance in the field circuit, it is necessary that the coil of the retaining magnet be connected in a circuit that is entirely independent of the field; if not, when the field current is weakened to obtain the highest motor velocities, the strength of the retaining magnet may not be sufficient to hold the operating lever in the running position. The arc of small contacts located at the top of the slate front, is for the purpose of varying the resistance in the motor field circuit. The regulating resistance is connected with these contacts, and the metallic curve above them is connected with one end of the resistance. The sliding contact on this curve, when in the extreme left position, short-circuits all the field regulating

resistance, and when in the extreme right position, cuts it all into the circuit.

In starting the motor the operating lever is advanced in the same way as in the ordinary motor starter, until it rests against the retaining magnet and is held by the latter in that position. This gives the slowest motor velocity. If it is desired to increase the speed, the contacting block that slides on the upper curve is advanced until the required velocity is attained. When the motor is stopped, the operating lever in swinging back to the stop position carries the contacting block with it; so that every time the motor is stopped all the resistance is cut out of the field circuit, and hence, there is no danger of starting the motor with a weakened field.

Circuit Connections of the Ward Leonard Variable-speed Controller.

The circuit connections of this controller can be readily understood from the wiring diagram, Fig. 2. The main starting two-pole switch is shown at *S* and the fuses at *K*. The controller occupies the center of the diagram and the motor is shown at the bottom. Tracing the current from the positive line, *P*, through the motor armature, *A*, it reaches the right

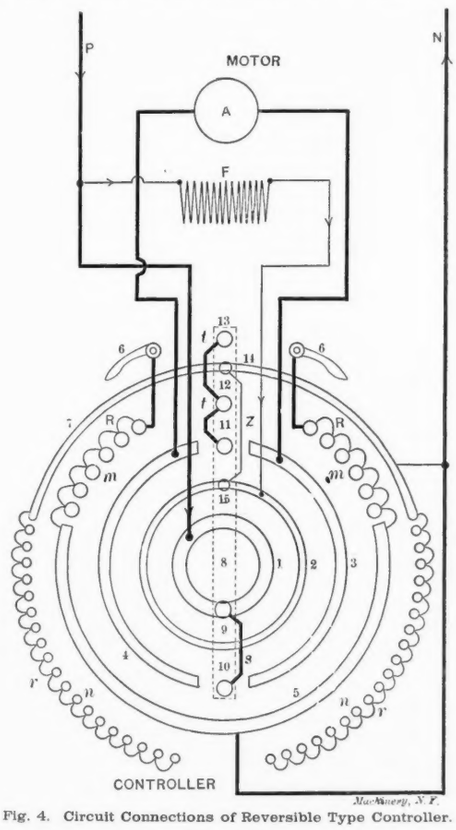


Fig. 4. Circuit Connections of Reversible Type Controller.

side, *m*, contact of the controller, and passing through the starting resistance, *R*, reaches the operating lever, *D*. Thence through the circuit-breaker lever, *E*, to contact, *J*, and through the coil of the circuit-breaker magnet, *C*, to the negative side of the line, *N*. It will be noticed that the field circuit starts from line, *P*, and after passing through the shunt field coil, *F*, of the motor, goes to the curved contact, *H*, which is connected with the right-side end of the field regulating resistance, *r*. From the left-side end of this resistance the circuit passes to the stud around which *D* and *E* swing, thus completing the field circuit. The retaining magnet, *B*, has its coil connected in an independent circuit that is connected in parallel with the armature, as is clearly shown.

In starting the motor, lever *D* is advanced slowly to the extreme right side position, where it is held by magnet, *B*. To increase the motor velocity above the normal, contacting block, *G*, is advanced toward the right until the desired speed is reached. When the motor is stopped, the extension of lever *D* carries *G* back with it to the starting position, and thus cuts out all the resistance in the field circuit. The extended end of *D* is insulated from the lower portion, as indicated by the shading at *i*.

The way in which this controller is mounted upon machine tools is well shown in Fig. 3, in which it is attached to the side of a Gould & Eberhardt shaper.

Reversible Controller for Variable-speed Motor.

The diagram, Fig. 4, gives the circuit connections of one style of Ward Leonard controller of the reversible type. The controller itself is shown in Fig. 5. The principal feature about this controller is that means are provided whereby the

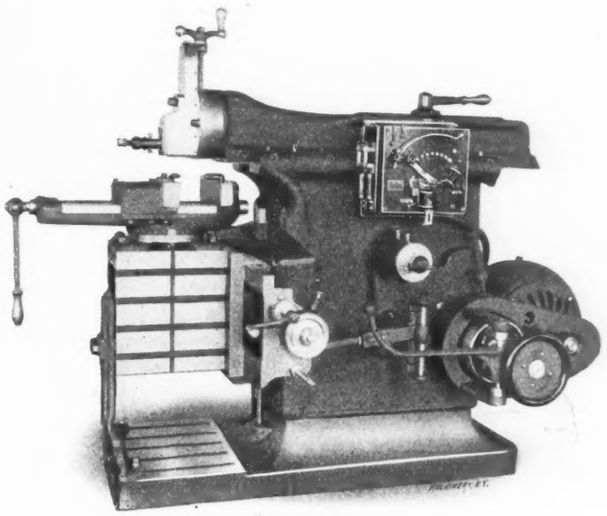


Fig. 3. Showing Controller mounted on a Gould & Eberhardt Shaper.

circuit is made quickly when the motor is started and is broken quickly when it is stopped. The effect of this quick make-and-break is to prevent excessive burning of the contacts, either by making imperfect contacts in the act of starting, or by slowly-drawn-out arcs in the act of stopping. In addition the construction is such that the circuit is closed in starting and broken in stopping at isolated contacts that are massive and capable of withstanding severe sparking, and thus the smaller contacts are protected and are prevented from becoming roughened at the points of separation.

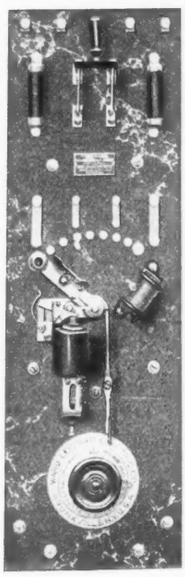


Fig. 6.

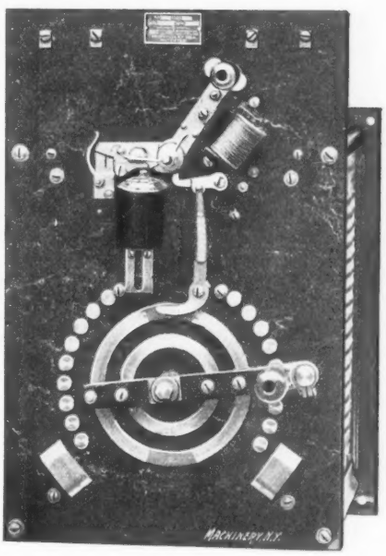


Fig. 8.

The operating lever 8 carries contacts 9, 10, 11, 12, 13, 14, 15. Of these, 9 and 10 are connected with each other as indicated by line *s*; 11, 12 and 13 are also connected with each other, by the lines, *t t*. Contacts 14 and 15 are connected by line *Z*. All these contacts are insulated from lever 8. The current passing from line *P* reaches the innermost contact ring 1, and if lever 8 is rotated clockwise, the contacts 8 and 9 will carry the current to segment 4. From this segment the current passes to the left side of the motor armature and returning from the

right side reaches segment 3. From segment 3, through the contacts 11 and 12, the circuit continues to the small contacts *mm*, with which the armature starting resistance is connected. Passing through these resistances the circuit reaches segment 5 and thence the line, *N*. If the operating lever 8 is turned counter-clockwise, contacts 9 and 10 will connect 1 with 3, and thus the current will reach the armature through the right side, and cause it to rotate in the opposite direction.

When lever 8 is in the central position, as drawn, the field circuit starting from line *P* reaches ring 2, and through contacts 14 and 15 and connection, *Z*, it reaches segment 7, which is connected with line, *N*. When lever 8 is rotated in either direction the first effect is to cut out the starting resistance, but after this is all cut out, contact 14 begins to slide over the small contacts, *n*, and thus cuts resistance into the field circuit, and the motor speed increases. As with the non-reversing controller, any motor speed desired, between the maximum and the minimum, can be obtained by advancing lever 8 until contact 14 is in the proper position.

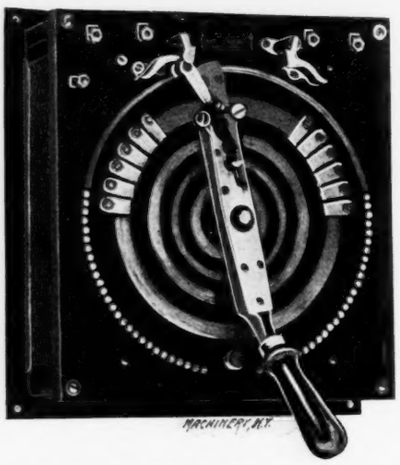


Fig. 5. Controller of the Reversible Type.

The Quick Make-and-break Action.

In Fig. 4 it will be noticed that the two contacts, 6 6, are connected with the end contacts, *m*. The contact 14 on the end of lever 8 is mounted upon the end of a lever that is pivoted to the back of 8 and is free to move sidewise against the tension of a retaining spring. This construction is clearly shown in Fig. 5. At the inner ends of the contacts, 6 6, are located latches, insulated from the contacts. When the operating lever 8 is turned to start the motor, this lever that carries contact 14 presses against the latch on 6 and is pressed back against the tension of the spring, until it is deflected enough to swing past the latch. It then flies forward and strikes the contact arc, 6, quickly, and with considerable force, thus insuring a good contact. This contact is made before 12 reaches the first *m* contact. In stopping, the action is the same with the exception that the lever that carries 14 is bent in the opposite direction until it can swing free from the latch on arc 6. It then moves rapidly and gives a quick break. In stopping, contact 12 passes off the *m* contact after 14 has connected with 6 but before it separates from the latter, and hence the circuit is broken between 14 and 6.

Other Forms of Controllers for Variable-speed Motors.

Fig. 6 shows another form of variable-speed controller which is a combination of a standard automatic motor starter, and a standard field regulating rheostat, mounted upon the same panel and provided with an interlocking lever to prevent starting the motor with any of the field resistance in circuit. The operation of this controller is made more clear by means of the diagram, Fig. 7.

Looking at Figs. 6 and 7 it will be seen that the operating lever, *D*, is provided with a catch, *v*, and that the rod, *L*, pivoted at *t*, engages with this catch when the parts are in the position shown. To move *L* out of the way so that *D* may be rotated and the motor started, it is necessary to turn the field regulator wheel until the lever, *K*, strikes *L* and moves its lower end to the left. Thus *K* must be returned to the position that cuts out all the resistance *r*, before *D* is free to move.

The interlocking arrangement shown in Figs. 6 and 7 is made use of by the Ward Leonard Company to provide reversible controllers with the protective devices of Fig. 1, that is, with the circuit breaker and the retaining magnet, so as to stop the motor if the current becomes excessive, or return the controller to the stop position if the current dies out. An arrangement of this kind is shown in Fig. 8 in which a reversing controller arranged for speed variation by means of armature resistance is provided with the protective magnets. In this construction the operating lever, *D*, is provided with a catch which engages with the hook on the end of the interlocking lever, if the lever, *D*, is returned to the stop position, and the interlocking levers are in the position shown. This is the position they will be in if the lower switch is in any but the vertical position. This latter position of the lower lever is the proper one for starting, as it cuts all the resistance into the armature circuit, and also draws the interlocking latch down so that lever *D* may be moved forward to start the motor. Hence, if the lower lever is in the proper position, which is the vertical one, the lever *D* can be moved forward; otherwise it cannot.

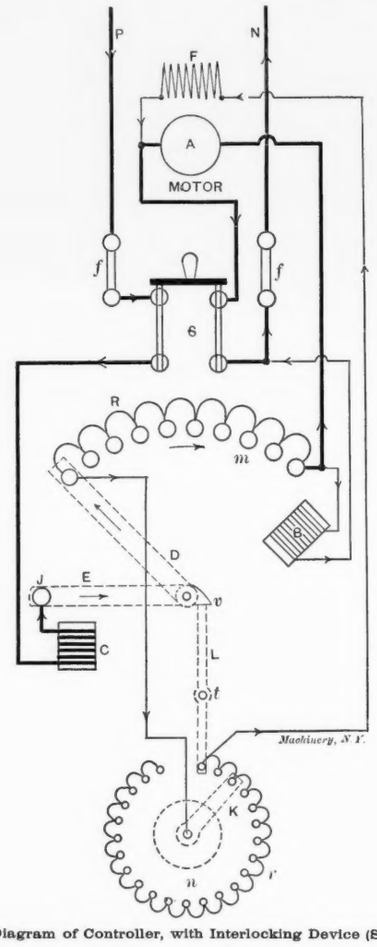


Fig 7. Diagram of Controller, with Interlocking Device (See Fig. 6).

* * *

The vineyardists of Southern France have found a peaceful use for the "villainous saltpeter;" instead of burning gunpowder to shoot their fellow men they employ it to cannonade the clouds. In other words, many of the communes now use small cannon for preventing the destructive work of hailstorms, it being alleged that the peculiar gyratory action of the upper air currents which produces hail, is broken up by the concussion of cannon-firing when intelligently directed, and in this way incalculable damage is often averted. It, however, is a moot question, and the people of adjoining communes, according to consul Covert, are by no means agreed as to the effectiveness of this—to us—novel practice.

ELECTRIC MOTOR DRIVE IN THE NAVAL GUN FACTORY.

The 14- and 16-inch gun lathes in the Naval Gun Factory at Washington, D. C., have recently been equipped with Crocker-Wheeler motors, as illustrated in the accompanying cuts, Figs. 1 and 2. Fig. 3 gives a general view of the main aisle of the gun factory, showing the arrangement of the lathes at work. Fig. 4 shows the aisle or bay, at the right of Fig. 3, at the headstock end of the lathes, and is intended to give an idea of the rope and belt drives which are displaced by the individual motor drives.

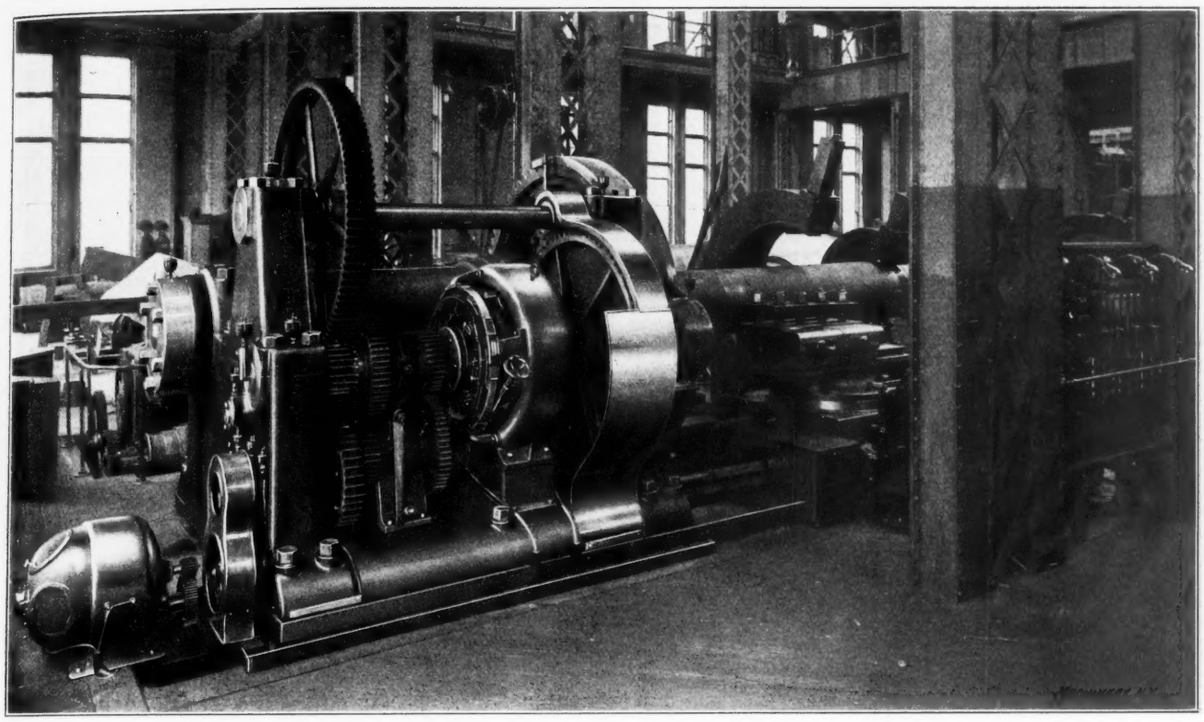


Fig. 1. Electric Motor Drive and Solenoid Switches applied to 16-inch Lathe in the Naval Gun Factory, Washington, D. C.

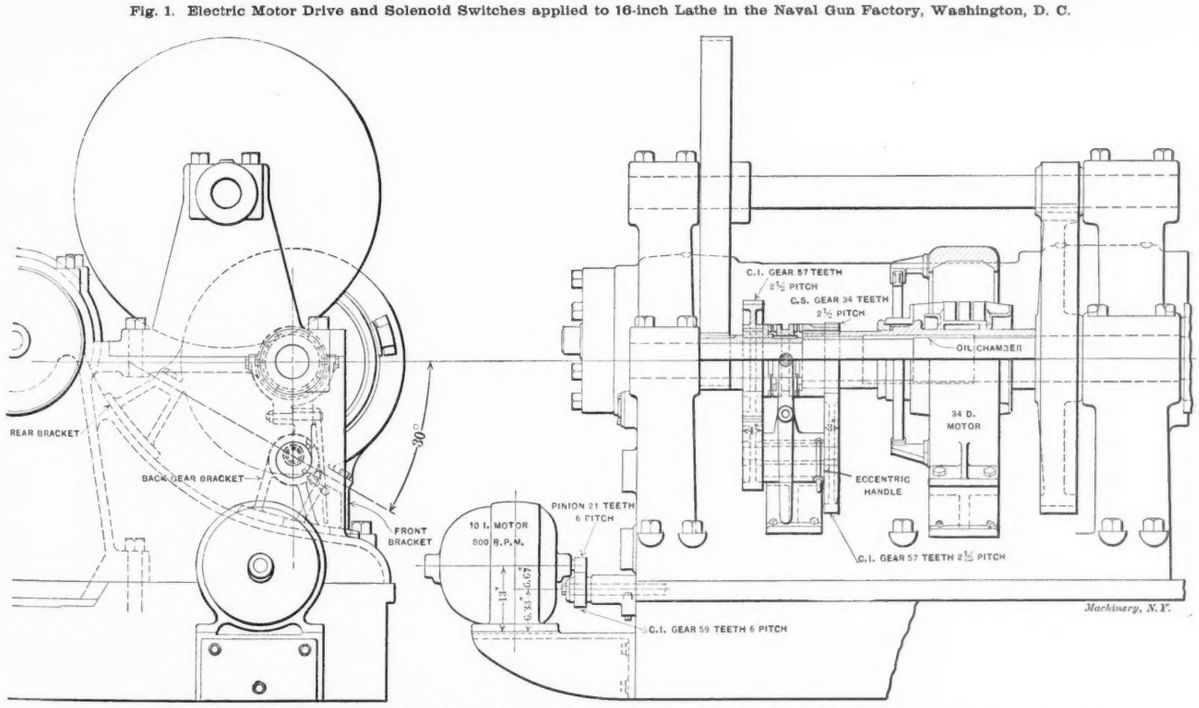


Fig. 2. Details of Electric Motor Drive for 16-inch Gun Lathe.

The main driving motor is of a special type built into the headstock, with the armature replacing the old cone pulley. This construction requires an especially large armature bore because of the large diameter of the faceplate pinion shaft that passes through it, and on which it revolves; but it makes possible a very compact arrangement, the motor drive being confined to practically the same limits as required for the discarded cone pulley. Since the speed range required on these lathes is approximately 10 to 1, it was necessary to add a back gear run having a ratio with the direct run of 2.8 to 1. The change from one run to the other is made by means of a double jaw-clutch operated by a vertical lever shown at the left of the motor, and directly beneath the clutch collar, Fig. 2. When using the fastest or direct run the back gears shown below the faceplate pinion shaft are thrown out of mesh by means of an eccentric lever in the manner common to ordinary engine lathes. Driving direct, the motor's working speed range is from 444 to 183 revolutions per minute, giving an extreme ratio of 2.4 to 1 in twelve steps. Throughout this range the motor will develop 30 horse power. Although lower faceplate speeds can be obtained by running

the motor slower, the power capacity of the motor would be reduced nearly in proportion to the reduction in speed. By throwing in the 2.8 to 1 back gear, the lower faceplate speeds can be obtained with ample driving power, since on the back gear run the power demand diminishes in proportion with the speed; the motor, then, of course, has ample power, and may run at any speed and yet be sufficiently powerful for all demands of the work. In other words, the demand for power is less with the slow cuts even though they be heavy and give the false impression of requiring great power. Therefore, using a motor speed range of 444 to 118 revolutions per minute, or a ratio of 3.75 to 1 on this run, gives a total faceplate working speed range of 10.5 to 1 with a possibility of increasing it to 21 to 1, by using even slower motor speeds, if very slow speeds are desired, as when setting up work, etc.

The speed variation of the motor is obtained by the use of the Crocker-Wheeler standard four-wire multi-voltage system, the maximum voltage between the outside terminals being 220 volts (see MACHINERY, June 1904, Engineering Edition). The controller is placed near the tool carriage, convenient to the hand of the operator. The controller proper, which is of the drum type, makes the proper voltage and field-weakening combination for each desired speed, but the main circuit is always broken outside the controller by two solenoid switches shown indistinctly at the right of Fig. 1. On passing from one voltage to another, a third solenoid switch is caused to open, thereby throwing resistance, called buffer resistance, into the main circuit, which prevents any undue rush of current that might otherwise occur. Having fulfilled its function, this resistance is automatically short-circuited at the end of a second or two. There are also two small solenoid switches so arranged that should any of the line voltages fail, the main switches will open and they cannot be closed again until the controller drum is placed in the "off" position. Push button switches are located at different points on the lathe for the purpose of making quick stops should such emergency occur.

The small semi-enclosed motor shown at the end of the headstock in Figs. 1 and 2 is a 10-horsepower shunt motor for giving a quick traverse to the tool carriages, and only used when traversing the carriage at high speed, as is desirable when shifting from one part of the work to another, etc. The feed and screw cutting motions are, of course, derived directly from the gearing driving the faceplate. The specifications for the 16-inch turning and boring lathes, which were built by Wm. Sellers & Co. some years ago, state that the bed is 73 feet 10¾ inches long, 9 feet wide, and 2 feet deep, and is made in two sections. The lathe was designed to give a safe cutting pressure of 140,000 pounds on 50 inches diameter when running at .4 R. P. M. An interesting feature of this lathe is that the tool carriages, of which there are two, are fed along the bed by a long nut revolving on a 6-inch steel screw fixed in the headstock and at the far end in the tailstock end of the bed. The carriage nut receives its feed motion from a square feed shaft driven from constant gears on the headstock, and its quick traverse from the small motor already described.

Fig. 3. General View of Main Aisle, Naval Gun Factory, showing Arrangement of Lathes at Work.

* * *

A neat method of keeping small miscellaneous screws and bolts in convenient and orderly shape for use in the shop, is employed by the Arthur Company, New York. It makes use of large glass tumblers of the jelly glass type, with pressed metal tops. The character and quantity of screws in each glass may be seen at a glance, and a desired screw can be selected from a large number of glasses with but a fraction of the mental effort required with labeled metal dishes.

SOME FAULTS OF INDEXING.

LEICESTER ALLEN.

Is the indexing of books a lost art? One would almost be inclined to affirm this after inspection of many modern books, testing their indexes by a comparison with their contents. Not only is this true of the books intended for regular perusal, but it is a sin that cries aloud in technical books required for occasional reference, and one that "smells to heaven" in books specially designed, and wholly used, for reference. No waste of time is so annoying—one might say exasperating—as that which is compelled while it is of a nature easily avoidable. Why it is that authors will expend untiring labor to gather and arrange the most valuable data in a book, and then send it to press with only a general table of contents for the various chapters, with no index whatever, or, at the least, an index so meager as to be almost worthless, is a puzzle for the practical mind. As well might a commercial man carefully fold, endorse and sort out letters, bills, invoices, statements, contracts, etc., and place these documents in a hundred separate pigeon-holes, without labeling the pigeon-holes. To find some particular paper one does not wish to be compelled to examine the contents of one pigeon-hole after another, till the right one is found; but the indexing of many books appears to be done on this principle; and quite often a general table of the contents of each chapter is thought sufficient. A business man could put up his deeds, bonds and

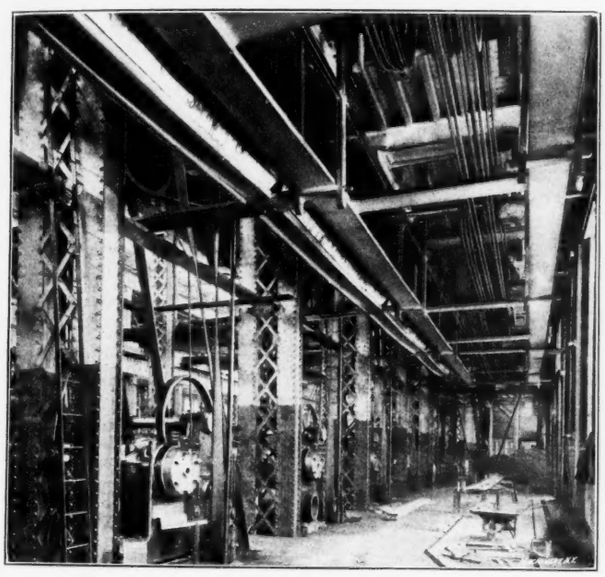


Fig. 4. Side Bay, Naval Gun Factory, showing the Belt and Rope Drives that were Displaced by Electric Motor Drives.

mortgages, letters and what-not into bundles, and tumble the different sorts into boxes or drawers and label the drawers; then, to get any particular paper, examine the entire contents of each box or drawer. But would any sensible man be content with such a system? Would such a jumble be worthy the name of system?

One book in particular is a conspicuous example of want of thoroughness in indexing. It will not be named here because this protest is raised against a general neglect and is not directed to single instances; but this book is a most useful example as illustrating how an otherwise most valuable compilation may fall far below its possibilities, simply from perfunctory work in its index. In this book are gathered together a surprising number of standard data, which in their entirety no engineer can carry in his memory, and as a handbook, the completeness and accuracy of its contents are not excelled in technical literature. But frequently a half-hour or even a longer time has been necessary to hunt down some item, known to be somewhere secreted among the great mass of material, simply because the index is an inefficient help. In some cases the matter in a paragraph, deemed of sufficient importance to have a capitalized heading, is not included in the index at all, unless its inferential inclusion in an indexed subject having a more or less remotely related title be called indexing. Although the use of the barometer in evaporative experiments, and other practical work, is referred to in various places in the text, the word "barometer" is not in the index. In one instance, a paragraph of nearly three hundred words on an important topic, has a heading in capitals containing three substantive words, each of which is of fundamental importance, and only one of these is in the index, while it there directs to a page treating of a widely different topic. If this were a solitary instance it could be excused; but it is probably one of a hundred or more similar faults, since, in using the book, not to find what is sought at the first effort is a usual result, and it is not uncommon to fail even at a second or third attempt; while to find some important data, one may abandon all hope of aid from the index, and roam through page after page in places where it might naturally find a fitting place, wasting time and patience. Nor is this a fault peculiar to the single book alluded to. This book is one only of a multitude of sinners. The indexing of English, German and French books is in general much more thorough than is the case with American books.

A common fault in indexing, where a topic is treated or referred to in some material relation to other subjects on a number of different pages, is to index the subject once only and follow with the pages on which some remark is made about it. This will be made clearer by an example. Opening the first book at hand, which happens to be a treatise on Heating and Ventilation, and which is only fairly well indexed, one of the listed topics is "Time required to heat buildings (pages) 256, 263, 286." On page 256 is a statement of the fact that when a building is to be intermittently heated, the capacity of the heating apparatus must be decided upon with reference to the time which can be allowed for preliminary heating before occupation. On page 263 is found a method of computing the time required for heating the walls of buildings. On page 286 is an account of the time required to heat a massive church building, as determined by actual experiment. Now suppose a person desires to find what is said upon any one of these topics; nothing in the index warrants that—although he knows the matter is in the book yet is not perfectly familiar with it, or if he has not used the work for some time—he will not be obliged to look in three separate places to find what he seeks. And if, in addition, he desires to find what is said of the time required for preliminary heating of buildings by stoves, he will not find this anywhere in the index, either under the word "stoves" or "buildings," or the title previously quoted, or under "heating," but will simply have to grope for it, like a child hunting for strawberries in a meadow. If his patience holds out he will find it on still another page of the book. It was easy to find this defect in a better index than is common with books of this class, and more might be as easily found. It would have taken the author of this book scarcely more time to have remedied each defect than every one of a majority of its thousands of readers wastes, time and again, in finding what he wants in similar cases.

The minds of men do not all work alike. In a technical paper is an article entitled "Extensible Planer Clamp Block." After the reading and laying aside of this article, say by twenty readers, to five of ten the word "Extensible" will be the word by which the pigeon-hole of memory will have been unconsciously labeled. Going to an index they will naturally seek that word, and should there find the complete title. Others will call up in memory the word "Planer," and looking in the index should find "Planer clamp block, extensible." To others the word "Clamp" will be the first to recur, and looking for this they should find "Clamp block, extensible planer." Every substantive word in the title of a topic will be found in a really good index. No reader should be compelled to look four times in an index to find any subject, if he looks for it in any natural, legitimate place where it might be placed. The fact that it might properly be so placed is proof that it ought to be there.

Another defect in indexing books, which some authors seem to favor, is indexing by paragraphs instead of pages. On the average it absorbs nearly twice the time to find matter so indexed as is needed for work with a page index. To find a

page one looks always at a place common to all the pages, most commonly the upper corner; to find paragraphs, one must scan the entire left-hand margin, and if, as often happens, the paragraph includes two or more pages, more time is consumed. The indication of both page and paragraph, if the work be well done in all other respects makes the most complete index; but it is probable that in the small number of such indexes extant very few literary workers use the paragraph numbers, or find them a material help.

It may be objected that such thorough indexing as is herein advocated, would make the indexes too voluminous. It would in many books more than double the number of pages required for their present indexing, and increase the cost of publication. As to the bulk, we reply that no index that does not repeat itself is too bulky for a work designed for constant reference. As to increasing the cost of publication, the objection holds; but if an increase of, say, five per cent, doubles the value and convenience of a literary tool, it is money well expended. A saw is one of our most efficient cutting tools, if it has a good handle, but while the blade may be of the very best quality, with its teeth filed and set to do the best work, if it has no handle, or only a make-shift handle, its usefulness falls far below its normal possibilities.

The defects named are also found in the card indexes now so much in vogue, excepting those in leading public libraries, the latter as a rule, being extremely good. How many whose work has required laborious research in these institutions have failed to recognize the fact that a good index supplies perfect and efficient handles to the literary tools with which they work?

* * *

IMPROVED LATHE OF THE TURRET CLASS.

Realizing that the modern turret lathe is more or less handicapped in the use of cross-slide tools, Mr. W. L. Cheney, Meriden, Conn., has recently secured a patent, No. 777,181, for a lathe design which increases cross-slide facilities. The object of the patent, therefore, is to enable an increased number and variety of cuts to be taken simultaneously upon work. In his patent specification Mr. Cheney details some of the objections to present designs of turret lathes substantially as follows:

"In turret lathes and machine tools of that class the slide-rest which is usually placed between the turret and tailstock or headstock, is oftentimes in the way of the turret and other tools, and the latter are in consequence required to be lengthened in order to reach over the slide-rest, thus making them unduly long and hence not sufficiently stiff for some purposes. In certain forms of heavy lathes a cross-slide has been placed on the turret itself whereby the latter may be rotated to get the cross-slide out of the way so that the turret may be moved up close to the headstock, thereby enabling the use of short tools on the turret; but in such lathes the cross-slide cannot be used at the same time that boring or other work is being done

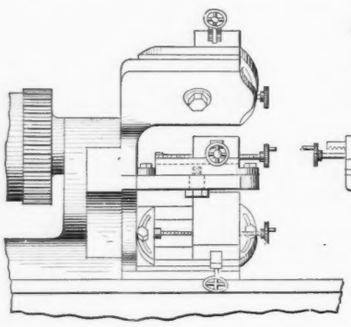


Fig. 1.

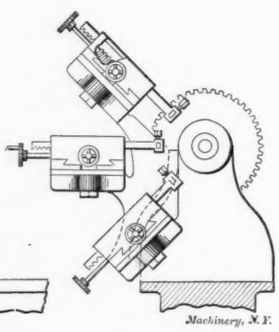


Fig. 2.

by the turret tools. In some other lathes the slide-rest is formed so that it may be run forward close to the headstock and beneath the work-holding chuck, but in this position it is of little or no use. In all the machines referred to only one crosshead tool can be cutting at a time."

Figs. 1, 2 and 3 show diagrammatically the essential features of the invention, the idea being a multiplicity of cross-slides mounted upon the headstock so that the periphery of the work may be attacked independently of the turret tools. The drawings show the slides on the front of the headstock, but it is the intention of the inventor to balance them with slides on the back, which, of course, increase the capacity of the machine, and tend to equalize the pressure upon the work spindle.

* * *

CORRECTION OF A CALCULATION "IN ECCENTRIC LOADING."

Editor MACHINERY:

In the September issue of MACHINERY, under the head of hydraulic punch and shear, an error occurred in the calculation. As the subject of eccentric loading is important, the following correction should be noted. (In connection with this refer to Fig. 5 in the original article.)

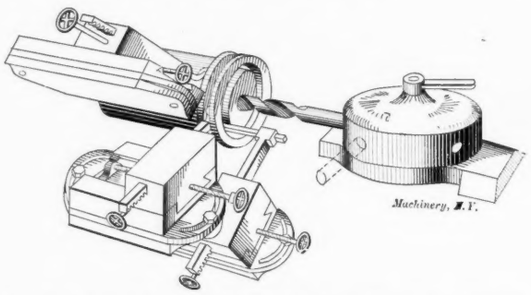


Fig. 3. Diagram showing Multiplicity of Simultaneous Operations on one Piece.

Capacity of machine, 100,000 pounds.

P = force acting on hooked portion of the housing
= 100,000.

L = 2 inches.

t = 1⅜. We then have

$$S_t = \frac{P}{A} + \frac{PLt}{I} \quad \text{.....(A)}$$

$$I = 2\left(\frac{bh^3}{12}\right) = \frac{bh^3}{6}$$

Substituting these values in equation (A) we obtain

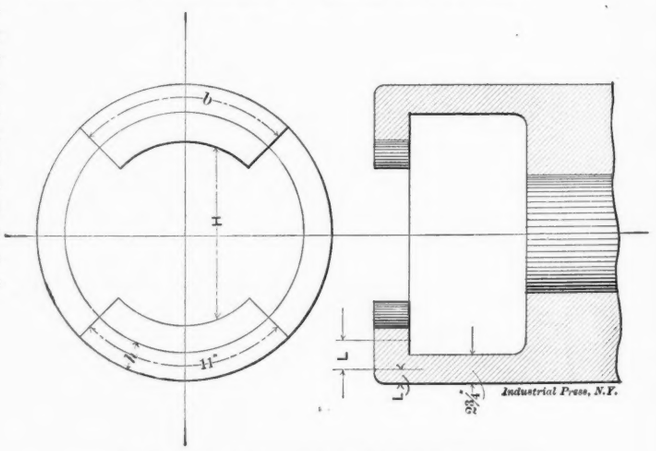


Fig. 5. (See original article in September, 1904, issue.)

$$S_t = \frac{100{,}000}{2\frac{3}{4} \times 11 \times 2} + \frac{100{,}000 \times 2 \times 1\frac{3}{8}}{\frac{11 \times (2\frac{3}{4})^3}{6}}$$

$$= \frac{100\,000 \times 11}{4 \times 11 \times 2} + \frac{100{,}000 \times 2 \times 11 \times 6 \times 4 \times 4 \times 4}{8 \times 11 \times 11 \times 11 \times 11}$$

$$= 1652 + 7220$$

$$= 8872$$

This is considerably more than the allowable stress for cast iron in tension. In addition to this excessive stress, these parts were machined and the outer skin of the casting, which is always tough and sound, was removed. This would undoubtedly reduce the strength somewhat.

Pittsburg, Pa. FRANK B. KLEINHANS.

DRAFTING ROOM PRACTICE.

RALPH E. FLANDERS.

The drafting room may be said to bear a double relation to the shop. It is the place where designs are originated, and so in a sense it is the head of the shop, furnishing it with the ideas which the machinist turns into concrete forms in iron and steel. On the other hand the drafting room may be the servant of the rest of the establishment, doing its calculating and its routine work of testing, etc., lessening the tax on the memory, and leaving the minds of the workmen and foremen free to the task of getting out the product. In different shops, the use which is made of these two functions varies—one or the other of them may be neglected. It is safe to say, however, that there are scores of shops where the drafting room is looked upon as an almost unnecessary evil, and grudged every cent which is spent in its salaries and supplies, when this part of the plant might be the servant of the whole, making the work go more smoothly and easily all along the

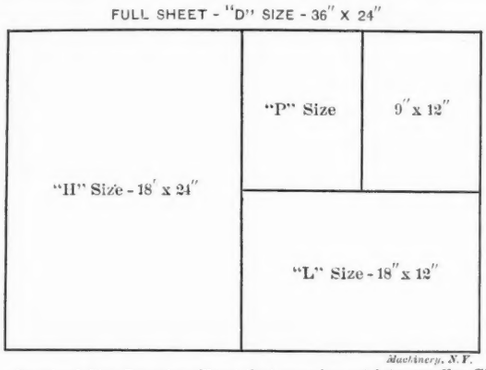


Fig. 1. Standard Size Drawing Sheet that may be cut into smaller Sizes.

line, from office to shipping room, if the men in charge understood how to get from it its full value. It is this second function which is perhaps least understood. In this article the writer will endeavor to show some of the different ways in which the drafting room may lighten the labors of the workmen, lessen the strain on the foremen, and grease the wheels of industry generally. We will neglect entirely the matter of design, therefore, and consider the routine office work of a typical shop. All the ideas which will follow have been put into practical and satisfactory use, some of them for years in the largest establishments in the country, while others have been worked out in the writer's own experience.

Systems will vary greatly in such widely varying lines as fire-arms, electrical apparatus and milling machines, but in order to take a case which will be most suggestive to readers of this journal, suppose it is required to equip with all necessary drawings, lists and records, a small shop building a line of machine tools.

Numbering the Parts.

We should have to start with a layout of the machine in hand, done to accurate scale, made either as a new design or a copy of a machine already being produced. The first question to consider is that of numbering the parts and arranging the detail drawings. A good way to number the parts, drawings, patterns, etc., is to give to each variety of tool produced a distinctive letter, such as "A" for universal mills, "B" for plain miller, "C" for vertical miller, "D" for shaper, and so on. Attached to this is a number distinguishing the size. "B2" is No. 2 plain miller, "L24" might be 24-inch lathe, and so on. The men in the shop and office alike soon fall into the way of calling the machines by these nicknames. Then each separate part is given a serial number. Thus "L20-49" might mean the back gear guide for a 20-inch lathe. This designation would be marked on the pattern and serve as a pattern number as well.

The arrangement of the parts in order for numbering depends on whether the parts are to be manufactured and fitted in assembling, or fitted each to the other in the process of making. We may take it for granted that the shop is trying at least to do business in a profitable way, so the arrangement will be considered from a manufacturing standpoint. The parts should then be grouped in such fashion that pieces having similar operations involved will be detailed on the same sheets. First will come the large castings, like the beds, legs, tables, heads, etc.; after, come the other small castings, involving milling and drilling mostly, as the brackets, levers, braces, gear guards, etc.; then the castings which are finished mostly by turning, like pulleys, gears, and bronze bushings. Next comes the group which includes the turned parts made from stock or forgings, such as spindles, shafts, steel gears, etc.; followed by a group of the small parts made on the screw machine. The last class contains the parts made by milling and drilling from flat and rectangular stock. If the parts are numbered and arranged on the drawings in some such order as this the workman who makes a specialty of certain operations will have all his work conveniently grouped together on the sheets.

Standard Drawing Sizes.

To obtain the greatest simplicity in handling and indexing in the drawing office, it is necessary to have a single standard size for the sheets. In the shop, however, big blueprints are a nuisance, and the sheets should be no larger than is needed to show a convenient number of the parts in the group being detailed. It is possible to satisfy the requirements of both shop and office by making the tracings of a standard size, and cutting the prints up afterward into as many smaller sheets as may be necessary. Fig. 1 shows how the convenient 36-inch x 24-inch "D" size sheet may be cut up into the other smaller sizes; thus it may make 2 "H" sheets, or 4 "L" sheets, or 8 "P" sheets, or 2 "L" sheets and 4 "P" sheets, and so on. The smaller size is especially suitable for the parts made on the screw machine. If an extra large sheet is needed for an assembly, or a full-size view of a large casting, a 36-inch x 48-inch sheet, or larger, may be made, folded into the standard sheet dimension, and filed with the rest.

Detailing.

Starting in the order in which the parts have been grouped, detail them out on large sheets sub-divided to suit the case in hand. Don't try to crowd them, but give plenty of room for changes and additions, and leave space in each drawing for adding other parts of a similar group, if this should be required in the future. The lower right-hand corner of each

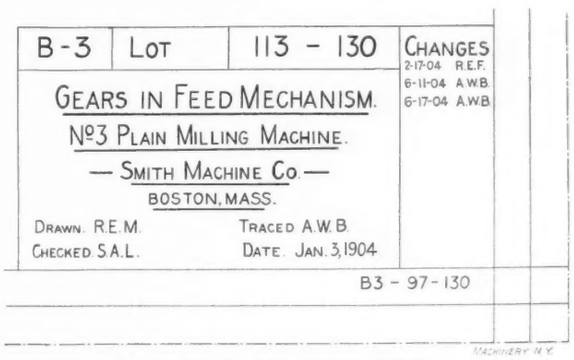


Fig. 2. Lower Right-hand Corner of Drawing

section is ruled off into a title, as shown in Fig. 2, containing on the top line the symbol of the machine, in this case B3, which means No. 3 plain miller, then the lot number, which is filled in on the print, and lastly the list of part numbers included on that drawing. The second line contains in large letters a title descriptive of the contents of that drawing; the next names the machine, and after that comes the firm name and the space for initials and dates. The column at the right, headed "changes," will be explained later on.

In assigning numbers to the parts, leave a few numbers out at the start to give to the assembled drawings when they are made. Begin by numbering the column, say, No. 15. Leave out two or three numbers, to give leeway if it is desired to add any new details to that sheet later on, and then number the knee and saddle, for instance, if they come next, 19 and 20. The first sheet then would include Nos. 15 to 18, and so 15-18 would be printed in the proper space in the top line. The drawing with the knee and saddle, containing only these two details might be numbered 19-23, and so on. In the same

manner, if the first group ends at 60, begin the next group at 100; that might end at 271 and the next begin at 300, and so on. Thus parts and drawings will be numbered in a flexible way which will make additions easy without deranging the list of parts. In the margin at the lower right-hand corner of the sheet should be placed the numbers inclusive of all the details on all the drawings of that sheet, as shown in the sample title, Fig. 2. This is for convenience in filing the tracings.

Dimensioning.

In detailing, the way in which the parts are dimensioned, the completeness of the information given by the dimensions and the notes, and the clearness of the drawing itself, all these points together make the difference between help and hindrance. Much has been written in mechanical papers, and much more said in the shop, profanely and otherwise, about the

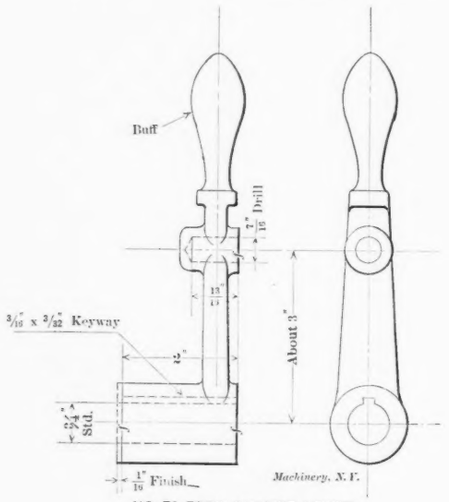


Fig. 3. Detail Drawing.

dimensioning of drawings. The draftsman must keep in his mind's eye the whole course of the manufacture of the piece, and give the dimensions in such shape that the workman will not have to add or subtract or multiply or divide this and that to obtain the measurement he requires. Of course no scaling of drawings is allowed in the shop. The ideal to be kept in mind is that of a drawing having information so completely given that the wayfaring man, though a fool, need not ask questions, but take the blueprint, follow it in blind confidence, and turn out work all completed save for the little squaring up of shoulders that may be needed in fitting it in place in the machine. In Figs. 3 and 4 are shown detail drawings, which more or less completely illustrate this idea.

Fig. 3 shows a cast-iron lever. The handle is not turned, but buffed, as noted. Since the body part has no finish given, it is painted to correspond with the rest of the machine. The ends of the hub and the face of the boss are marked "*f*," which means "finish." This idea is sometimes carried out more completely by making f^1, for instance, mean a ground surface, f^2 a filed surface, f^3 a smooth-turned, but it is much less confusing to write out in plain English, whatever finish may be required other than that left by the cutting tool. Do not be afraid of putting in the drawing any notes which will aid the operative. "Finish" is often indicated by a red line about 1-16 inch outside of the finished surface and parallel with it. This is the best and clearest way on paper drawings, and blueprints as well, when the red lines print well, but it takes good paper and careful printing.

The dimension from the center line of the hub to that of the boss is marked "about 3 inches." This means that the centralizing of the holes in the casting is of more importance than the actual dimension given. The hole in the hub is marked "¾," "std.," or "standard," which means that it is to be reamed to fit a standard plug gage. The hole in the hub is marked "drill," which shows that it is not to be reamed or bitted, but left as the drill leaves it. It will be noticed that a "fit" of 1-16 inch is indicated at one end of the hub. The workman who squares up the casting at this point must leave 1-16 inch for the fitter to remove in putting the machine together. In the same way "fit" is indicated on the drawings of all shafts, etc., where it is necessary to square up a shoulder to make an end fit. This relieves the lathe hand of all speculation as to where his fits come. Under the detail are placed the part number, the name, the material of which it is made, and the number wanted for each machine.

There are no casting or pattern dimensions given in the detail. It is an unmitigated nuisance to have the shop drawings obscured by a maze of dimensions which are never used but once, when the pattern is made. These pattern figures may be placed on the paper drawing from which the tracing is taken, or they may be put in with a yellow pencil on a blueprint taken specially for that purpose. Of course when it is necessary for a finished surface to bear a definite relation to a rough surface, dimension lines may be drawn from that point, but otherwise the shop should have to do only with the finished surfaces.

The detail drawings for the patternmaker should show the draft plainly wherever it is required, show the manner in which a finish cut terminates in the rough casting, and, in general, give a true picture of the piece as it will look when finished in cold metal. This relieves the patternmaker of all guesswork as to whether he ought to add or take off the draft, and, when combined with careful patternmaking, furnishes a record of the exact shape of the castings, which will be useful in estimating clearances in future changes.

Fig. 4 shows a sample detail of a steel pinion and shaft. Limits are shown for all the diameters. The determination of limits calls for good judgment on the part of the draftsman. It is very natural for him to put the standard much too high, while the shop often complains of the closeness called for, not realizing that by the old cut-and-fit method much closer work was done than is needed or called for under the limit system. Limits may be expressed in two ways. For instance, a running fit on a shaft to go in a 1¼-inch standard hole in a bronze box may be marked $1\frac{1}{4}\ \begin{cases} -.001 \text{ max.} \\ -.0015 \text{ min.} \end{cases}$ or it may be expressed $\begin{cases} .249 \\ .2485 \end{cases}$

The first way may be best for shops where the workmen have not yet become acquainted with their micrometers, but it savors strongly of the "⅞-inch plus 1-32-inch less ½ of 1-64-inch" of our forefathers. In the better shops of the country the very errand boys learn to use the micrometer with ease and skill, so it would seem that the second method of marking the size ought not to puzzle the workmen very long. In either case the larger dimension should be on top, to catch the eye first. In places where there are no limits given, of course it is understood that good accurate scale measurement will do.

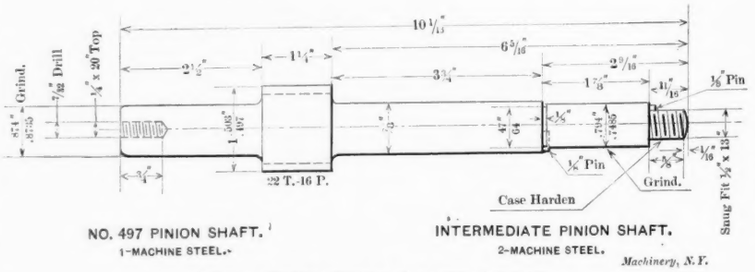


Fig. 4. Another Example of a Detail Drawing.

On the drawing, the tap drill size and the depth of a tapped hole are shown. The two journals are marked "Grind," which means "grind to size"; the one into a plainly shown recess, the other, where the box does not come within ½ inch of the shoulder, up to the fillet. In general it is intended that the dimensions shall be so arranged that the lathe hand will be able to use them as they stand without bothersome calculation. On work made from the round or rectangular bar, finish marks

are omitted. If it is desired that the piece be left rough at any point, the words "stock size" may be applied to the figures describing that dimension. For instance, on a 1¼-inch cold-rolled shaft turned up for a short distance at each end, the central part would be dimensioned 1¼-inch "stock size." This particular piece is used twice in the construction of the machine, and in different localities, so it is given two names under the same part number.

Part Lists.

Two lists are required: A list of detailed parts, and a list of stock parts. Every single item of a given machine must be recorded somewhere, either on the blueprints or in the list of screws, washers and other sundries taken from the stock-room or purchased outside. A page heading for the list of parts in the casting group is shown, upper sketch, Fig. 5. The first column gives the part number; then comes the name, then the number wanted, the material of which they are cast, and lastly, two columns marked "castings ordered" and "order filled." These spaces may be conveniently checked by the one who orders the castings, and he will thus have a good idea at any time of what progress is being made in supplying the needed material. This does not, of course, take the place of whatever foundry order system may be in use. The page heading of the parts made from the bar and rod are also self-explanatory, the last two columns being filled in with the dimensions of the rough stock needed to make each piece. It will be remembered that numerous blank spaces were left in numbering the parts, to give room for future changes. Similar gaps should be left in the list of parts.

The "List of Stock Parts," of which two sample headings are shown, must cover everything not otherwise provided for, and give all the information necessary for ordering. Leave plenty of room here, as well, for additions and alterations. These lists may be done in ink on printed and ruled blanks of thin bond paper, or they may be typewritten for blueprinting in the following manner: Do the work in a good strong manifolding machine with a new black ribbon. A piece of carbon paper should be placed in back of the sheet with the face against it. This prints the back of the sheet as well as the front, and makes characters heavy enough to make blueprints in fine shape.

If these lists are printed, clipped together in tough paper covers, and distributed generally among those who have any use for them, they will save a vast amount of useless mental strain. Before a new lot of machines is ordered the stock-keeper can go through the list and see that he has every last screw and washer on hand that is needed. The man who orders the castings can look over the supply on hand and govern himself accordingly. The man who has charge of the bar stock can keep himself supplied with the necessary material, and cut it off of the proper cross-section to the proper length as fast as it is needed. The foremen in the shop can assure themselves that nothing has been forgotten, that everything is coming along as it is wanted, and have in general a constant reminder at hand of what is required of them.

Assembly Views.

After all this has been done, we may make the necessary assembly views, working entirely from our detail views and stock part list. If the parts all go together in good shape, it is an indication that the job will check up well. On these drawings, at least, and perhaps on the details, it is a good plan to use some simple method for distinguishing the various classes of materials by the cross hatching. It is good enough to have one style for steel and wrought iron, one for brass, bearing metals, etc., and one for cast and malleable iron.

Tracings.

Next comes the tracing. If the machine is a new one, never built before, it is a good plan to shellac the paper drawings and send them out into the shop for the first lot. This will make the inevitable changes easier to handle than when blueprints are used from the start. As soon as the machine is well in hand, the drawings may be recalled, cleaned with alcohol, and traced. It is of great importance to use the very best grade of tracing cloth. Not every well-advertised brand will stand the rubbing and scrubbing of a draftsman who has the fever of improvement seething in his brain. It costs much less to get the best tracing cloth at the start than it does to have to make new tracings on account of having cloth that will not stand erasure.

Checking.

The checking may now be done. It is best to delay this until after the tracings are completed, and then it is done once for all; and it can best be done by some one other than the man who did the detailing. If, however, it be gone over in some orderly, systematic way, it may be as well done in a one-man drafting room as in some large establishments the writer has seen, where the drawings are examined and initialed by every one in sight, from the engineer in charge down to the sweeper.

Think over beforehand every direction in which a mistake is liable to occur, and make a table covering these chances of error, and tack it in plain sight on the wall over the desk. For such a system as that we are considering, the following list might be appropriate:

1. General design.
2. Finish.
3. Dimensions; sufficiency and arrangement.
4. Dimensions; compared for accuracy.
5. Compare with list of parts.
6. Compare with list of stock parts.
7. Pattern number.
8. Notes.
9. General title.

That is to say, beginning with the first part in the list of detailed parts, we would examine it first for points in its general design. 1. Is it well proportioned, strong enough,

Casting Parts.

Part No.	Name	No. Wanted	Mat'l	Castings Ord'rd.	Order Filled
115	Vise Body	1	C. I.		
116	Vise Swivel Base	1	C. I.		
117					
118					
119	Table Stop Clamps	2	C. I.		
120	Table Stop Abutment	1	C. I.		

Bar Stock Parts.

Part No.	Name	No. Wanted	Mat'l	Section	Length of Blank
411					
412	Vertical Feed Shaft	1	M.S.	1⅜" Diam.	13¼"
413	Elevating Hand Wheel Shaft	1	C.R.S.	1⅛" Diam.	17⅛"
414	Telescope Shaft	1	M.S.	1⅜" Diam.	15½"
415	Telescope Quill	1	Steel Tubing	1⅝" I.D. 1¾" Diam.	12⅜"

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Fig. 5. Headings for Blueprints, giving Lists of Stock Parts.

and in general harmony with the lines of the rest of the machine? Could it be changed so as to require less machining, or to make it cheaper to mold (if a casting)? 2. Is there any unnecessary finish, and has the needed finish been properly indicated? 3. See that the dimensions are sufficiently full, and arranged in such fashion that the workman will know, without figuring, the dimension he needs. 4. Compare the dimensions of the detail in hand with those of every single contiguous and related piece in the whole machine, whether detailed or given in the list of stock parts. This is the important item in the list, and if it is faithfully carried out it will double-check every dimension, as each part is thus checked up once individually, and again in the correcting of other related parts. 5. Compare titles and stock dimensions with entries in the list of detailed parts. 6. See that every stock part which is related to the detail being considered is properly entered on its list. 7. If the detail is a casting which has no pattern of its own, but uses that of some other part of the same or another machine, see that the proper pattern number is given under the title. 8. Be sure that notes are given, to supply the workman with all the information he needs as to fit, finish, etc. Otherwise he will worry the foreman with fool questions. 9. After the details have been checked, as above, see to it that the title of the drawing is correct as to part numbers, names, etc.

In the same fashion the lists must be gone over, checking every name, number, note and dimension.

Printing, Mounting, Etc.

The tracings may now be blueprinted, cut up into the proper sections, and mounted on suitable boards. Do not send them out rolled up, to get defaced and torn, and refuse to lie flat in

the files, when they are returned. Then they may be distributed to whoever needs them. With the details intelligently grouped as described above, and with not too many on a drawing, one set of detail prints ought to suffice to put through a single lot in the shop. Be generous with the lists, however, and put them wherever they can be of any service. Stamp each print, in red, with the date when it was printed, and keep a record of prints made and delivered to the shop. This record will be found very valuable when making changes as described below.

Changes.

In a shop which is alive the product is in a constant process of improvement, so it is necessary to make a full provision for this state of affairs in a good drafting room system. In the first place the men in the shop should on no condition be allowed to make an erasure or addition of any kind to the shop prints and drawings. If an error is discovered or an improvement found advisable, let it be reported at once to the draftsman, who should stand ready to make any needed change with promptness and good grace. In general practice, however, it will be found best, from the drafting room standpoint and that of cheapness of production as well, to delay radical changes until a new lot is begun. In some places the foremen and other prominent men are furnished with stub books in which they write suggestions for the improvement of the different lines of machinery. The leaf is filled out in duplicate with the stub, and sent to the drafting room, where it is considered either immediately or when a new lot is ordered, according to the urgency of the case. This scheme gives the draftsman the advantage of having all the "kicks" and helps in tangible form, for ready reference, and also gives the credit to the men who hold the duplicate stubs.

In the same manner that the checking was done it will be found advisable to make out a list of everything which might require attention in making alterations of any kind. The following table would cover about everything. This ought also to be printed and nailed on the wall in plain sight of the draftsman:

1. Detail tracings.
2. Assembly tracings.
3. List tracings.
4. All prints (detail, assembly and lists).
5. Patterns.
6. Special tools.
7. Record of changes.

In making a change, if it is at all elaborate, it is safest to sketch it out on detail paper before making changes on the tracing. In erasing tracings, use any smooth sand eraser which has been approved by experience, and place under the part being treated a sheet of some smooth hard substance like celluloid, sheet metal, or a round-edged piece of glass. This will remove the ink without giving the rubber a chance to deeply abrade the cloth itself. Cases sometimes occur in which a comparatively simple change, like shortening the over-all length of a complicated casting would entail a considerable amount of labor. To avoid this, the dimensions only may be changed, and then circled, as in the small sketch, Fig. 6. This gives notice to whomsoever it may concern that the dimensions are out of scale, so that the drawing will not measure correctly. Where the change is one of 1-32 inch or less, it is not advisable to alter the lines of the detail or circle the figures.

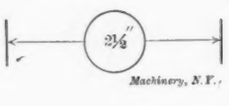

Fig. 6.

The assembled drawings should be kept up to date if they are to serve any purpose at all. In some cases it might be permissible to introduce circled dimensions on these tracings as well, where an otherwise small change would require much scrubbing. The lists also must be corrected, of course.

There are two ways of changing the blueprints, where the change is so small as to make a new print inadvisable. One way is to use the "soda solution" which acts chemically on the paper itself. This gives the most permanent results, but requires some skill in handling, as the lines do not appear until some time after the liquid has been applied. Chinese white, ground in water, can be used like ink, and easily removed when desired—so easily, in fact, that it is best to shellac the changed portion of the print to preserve the lines. With either method it is best to draw in the new lines first, and then obliterate the old ones with a blue pencil, this being the only known method of erasing on a blueprint. Be sure that every print of each tracing is changed—the list of prints charged out will tell you this. If new copies of a print are required on a change, destroy the old ones; do not leave them lying around, to cause trouble.

Patterns and special tools must be looked up for each individual case, and duplicate written orders made out for changes, one to go to the toolmaker or patternmaker, and the other to be kept in the office as a record until the work is reported finished.

LIST OF SQ HEAD SET SCREWS.

NAME OF SCREW.	NO WANTED	DIAM.	L'GTH	MAT'L	FINISH	POINT
To hold Dog # 89 on Shaft # 417	4	3/8" x 16"	1 3/4"	Steel	C.H	Cup
" " Rod # 468 on Bracket # 111	1	3/8" x 16"	1 3/4"	Steel	C.H	Cup
" " Gear # 126 on Shaft # 439	2	3/8" x 16"	1 3/4"	Steel	C.H	Cup
" " Stud # 488 in Holder # 97	5	3/8" x 16"	1 3/4"	Iron	Soft	Oval
" " Roll # 512 on Pivot # 542	12	3/8" x 16"	1 3/4"	Iron	Soft	Oval

LIST OF FURNISHINGS.

DESCRIPTION	AMT PER MACH.
Single Belting - made Endless - First Qual. - 1½" Wide.	13 Ft: 7 In Endless
Single Belting - First Quality - 1" Wide.	49 Ft
Round Belt - ¼" Diam. - Furnished with Couplings.	3 Wanted: 11 Ft each
"Cosmolubric" Oil.	2½ Gallons

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Fig. 7.

Referring again to Fig. 2, there is shown at the right of the title a column headed "Changes." After each change is completed and checked up, the person making the change should enter here his initials and the date, in small legible characters. A "Record of Changes" book should be kept. Under the date signed in the "Changes" column there should be entered a brief description of the alterations, giving exact dimensions, and perhaps the reason for them as well. A separate book should be kept for each line of machines manufactured. By comparing the last change date on a print with that on the tracing it can immediately be determined whether or not the print is up to date. By referring to the given date in the "Record of Changes," the exact scope of the alteration can be found at any time. This will be found a great convenience.

In cases where an error has been made in the shop on a machine, and a deviation from the drawings in that particular case will save a large amount of costly labor and material, this change may be made; but it must be recorded, for convenience in making future repairs and attachments. It is the proper thing to number the machines of a given kind and size serially, beginning, for instance, by numbering the first 20-inch lathe built, No. 1, the next one No. 2, and the one hundred and seventy-eighth one No. 178, and so on, as long as the machines are built. This number should be stamped in a prominent place, and attention called to it in the catalogues and other printed matter of the firm. A book for a "Record of Machines Shipped" should be kept, with a page for each individual machine. This page is numbered with the tool's serial number, and contains information as to whom the machine was sold to, a record of the inspector's tests, a description of any change from the standard drawings used on other machines in the same lot, and a record of all attachments furnished, repair parts sent, complaints from user, etc. It is easy to see the value of such a record as this in furnishing new parts, remedying defects, and estimating the values of various designs.

After each lot of machines has been approved ready to ship, all the prints—detail, assembly, and lists—should be returned to the office. A complete set should be taken from them and the duplicates destroyed. File this set of blueprints away in a folio the size of the "H" sheet, doubling the "D" size to do this. As far as the work done in the home shop is concerned, this, with the office book, will furnish a record of each individual machine for all time, no matter whether it goes to

Lapland, or stays in the town where it was born. These folios should be kept indefinitely.

It is not feasible to try to make the tool drawings of jigs, special cutters, etc., on full-size sheet, even though divided, as the standard parts are. These should be made on a suitable standard size of a good grade of detail paper in a quick sketchy way, shellaced, and sent into the shop. Number these drawings with the symbol and part number of the detail for whose manufacture it is used, adding a serial number as well. This serial numbering is common to all tools made, no matter for what purpose, and is to be given them in the order the drawings come from the office. Thus if L 22-75 is the part number for the spindle of the 22-inch vertical driller, the finishing taper reamer for the hole in the same might be numbered L 22-75-193. If A-4-267 is the index wormwheel for the No. 4 universal miller, and the next tool drawing made is a hob for same, it would be numbered A 4-267-194. These numbers should be stamped or etched on the different tools as soon as they are made.

A book should be ruled up for a "List of Tools." A sample page heading is shown for this in Fig. 8. The tools are entered serially as fast as drawn. The first column gives the date when drawn, the main part of the page, the description. Next is a space for a list of parts for which this tool is used other than the one it was made for. As changes are made, old numbers are crossed off from here and new ones added, so plenty of space must be allowed. For convenience in finding the drawing, the last column gives the standard size of sheet on which the tool was drawn. It will be noted that one tool is marked "None." This tool was made in the shop off-hand, without any

DATE	TOOL NO.	NAME.	USED ALSO FOR.	SHEET.
2-17-04	H14-76-276	.498" Rose Reamer for bushing holes in Stop Slide	(H7-96) (K1-72) (L14-472)	None
2-17-04	B2-28-277	Jig for bushing holes in Gear Box.		D
2-18-04	B2-28-278	Boring Bar for bushing holes in Gear Box	(G2-43) (H6-82) (L17-24)	L
2-20-04	L17-480-279	Gang Rack Cutter for Feed Rack.	(L20-480) (L24-480)	P

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Fig. 8.

drawing to go by, but it was entered on the list and its tool number marked on it, to give it a local habitation and a name. These tool and jig sheets should be filed in a drawer of their own, divided into compartments of suitable size, and all arranged with serial numbers in order, the lowest at the bottom. The jigs and tools themselves are best arranged with the serial numbers in order, since this will avoid constant rearranging as the stock increases. To find them readily an index list should be prepared, giving the standard machine parts in numerical order, and listing under each one all the special tools used in its production, whether those tools were originally made for it or not. Of course much of this system of keeping track of special tools is required only in shops where they are used in large numbers, but that may be taken for granted if the concern is in earnest about doing a profitable business on a large scale.

In cases of special machines or outside work of any kind, which does not come under the head of standard product, the same system may be followed as a whole, with the exception of the symbol for the machine, which should be given a serial number instead of the letter and size number of the regular product. A record of these serial numbers should be kept in the office, and the drawings filed away, if the job is important, in the same manner as the standard blueprints. Attachments to regular machines, made up separately, may follow the entire system for standard parts. The symbol describing them may be formed by adding a letter to the symbol letter of the machine. Thus AA-3 would be "Vertical Milling Attachment for No. 3 Universal Miller"; BD-4 would be "Rack Cutting Attachment for No. 4 Plain Miller," etc.

In place of the record books suggested, it might be better to use loose leaves, with punched holes, and held in suitable binders. These leaves could then have proper entries made on them in the typewriter, and thus save hand work. It will be noted that in no case are there any forms used in such numbers as to require the use of printed matter, so the initial expense is small. Printed forms, card index systems, etc., may be evolved as the shop grows.

In recapitulation, a drawing office managed in some such way as this will give the firm the benefit of the following advantages:

Complete tracings and blueprints, easily filed and indexed, and made in such a way as to give the fullest, clearest information possible to the workman.

Complete list of parts as a convenience in tracing the progress of the work and keeping up the supply of raw material.

Complete list of all stock parts, for the benefit of the assembling foreman and the stock-keeper.

A list of all tools used for any given part, and ready means for finding the same, also means for ordering duplicate tools by number from the original drawings.

Means for making all changes entailed by changes in the product, in a simple, comprehensive way, and for making a permanent record of same.

A record of the suggestions made in the shop and office, for the drafting room in making changes, and for the firm in determining the relative value of their employes.

A full individual history, by means of the office record and the filed prints, of each machine built, useful in many obvious ways.

There are many men to whom the suggestions given above will seem the veritable A B C of the business; on the other hand, there are dozens of places where the suggestion of doing things in some such way as this would be considered a dangerous and revolutionary proposition. Practically all the work covered by a good system has to be done by someone, some time, and if it is not done decently and in order, it will be done in vexation of spirit, and with waste of time and money. The writer hopes that the suggestions here given may be of assistance to someone who has on his hands the task of starting a new drawing office, or the more discouraging job of inspiring with life the dry bones of an old one.

* * *

A long-distance pneumatic tube system has been proposed to transmit mail and express matter between Chicago and Milwaukee. This is a distance of 84½ miles, but packages would make the journey in only 40 minutes by the proposed tube, which would have a speed of about 120 miles per hour. The tube is intended to be 18 inches in diameter, laid entirely underground. It would convey loads up to 500 pounds, and would be run in relays of from two to three miles each, each section operating independently of the others, power automatically being cut off from a section upon the entrance of the mail carrier into the following section. The carrier would not be forced through the tubes by means of high pressure, as in other systems, but would be carried along by a vacuum. The cost of installation of such a plant would be $5,000,000, but the cost of operation and maintenance of the system would be so low that it is figured that the company could afford to carry 500 pounds for 15 cents.

As yet there are no long-distance pneumatic tube systems in operation, but contracts for several are now pending. Quite a number of systems of lesser length are now in operation in the United States, the longest of which serves the Chicago post office. This system is 9 miles long, and connects various postal and railway stations in Chicago with the old post office building. It has a capacity for carrying 3,000 letters per minute each way, and cost $650,000.

* * *

It is said that if steel is alloyed with manganese to the extent of 4 to 5½ per cent, it becomes so brittle that it can be pulverized with a hammer. A further increase, however, of manganese causes the steel to become ductile, yet very hard, the maximum degree of these qualities being reached with 12 per cent of manganese. A peculiar feature of manganese steel is that the ductility is produced by sudden cooling, or treatment directly opposite that followed with carbon steel.

NEW BATH UNIVERSAL GRINDING MACHINE.

A universal, combination grinding machine, having many ingenious features, has been brought out by the Bath Grinder Co., Fitchburg, Mass. This machine is the invention of Mr. John Bath, who for many years has devoted his time to the development of grinding machinery, and was the inventor of the Bath universal combination grinder described in MACHINERY for October, 1902. The new machine, while retaining some of the features of the older one, is in other respects entirely different and embodies many improvements. It is now built in two sizes and other sizes are to follow.

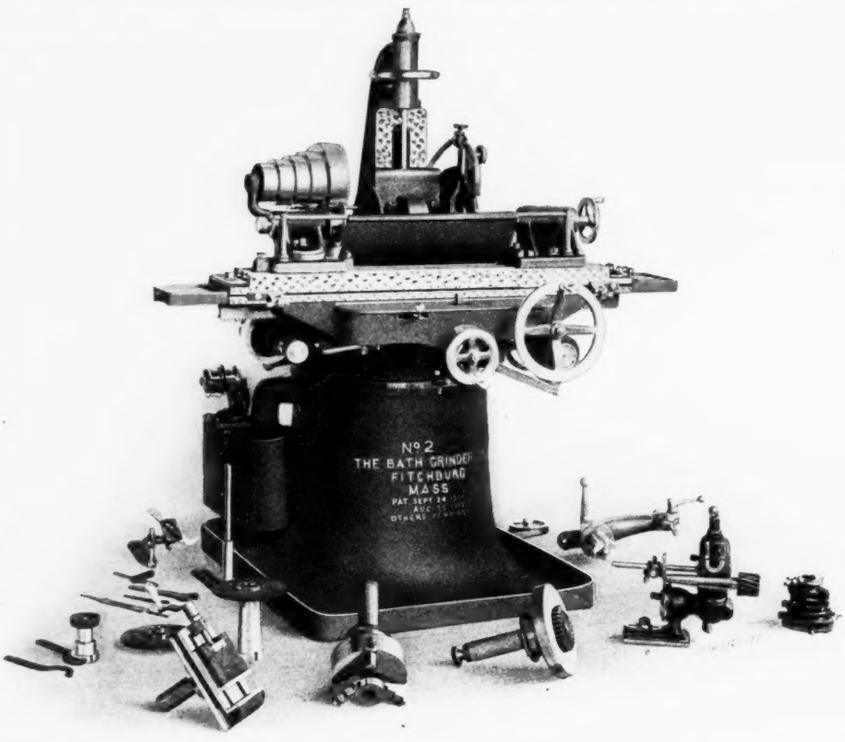


Fig. 1. Bath Grinder. Front View, showing Fixtures.

Among the features to which attention is called are, the design of the frame and table slide, by which the table may be swiveled about the vertical axis into any desired position relative to the wheel; a vertical grinding-head slide, by which the wheel may be made to pass vertically over the surface of the work for certain operations, instead of horizontally; a combination holder by means of which cutters and many other pieces of work to be ground may be held at any angle; and grinding wheels formed with faces of several diameters, which permit a variety of work to be performed without changing wheels.

The front view of the machine, surrounded by its fixtures, is given in Fig. 1. It has a large circular base, on the top of which is a projecting flange. Upon this base flange is another flange, concentric with it, which forms the bottom portion of the column used to support the grinding head. This column has vertical ways, on which the grinding head travels. Upon the graduated flange forming the base of the column is pivoted a swiveling bottom slide which carries the cross and longitudinal slides that support the work table.

In Fig. 2 is a back view of the grinder which clearly shows the pivoting slide that supports the table and that may be swung through any angle and clamped by the handles appearing at the base of the upper flange. This slide is made with long ways, so that even when the table is in its outermost position it will not overhang, but will still have the solid support of the slide and the base of the machine. Water from the wheel passes through a wide opening in the center of the slide into a puddle pan at the bottom of the inside of the base and is pumped back to the wheel by a centrifugal pump through the hose, as shown. The spindle-driving pulley and cone pulley are in one casting which runs on a stationary shaft. The face of the spindle-driving pulley is $\frac{5}{8}$ inch wider than the belt, and therefore keeps the two belts apart. The cone is supported by a frame pivoted on the back of the machine and arranged, by means of a compression spring, to automatically maintain the same tension of belt at any position of the grinding head. An independent tightener is also provided, to take up the slack of the belt as it stretches.

The table has automatic longitudinal and cross feeds (the latter is automatic in the larger size only), and is fitted with the usual swivel plate the same as any universal grinder. This swivel plate has two slots for clamping purposes, and one V-groove on the front for guiding the head- and footstocks, which have one V and one flat bearing.

The machine is adapted for all classes of cylindrical and conical grinding within its scope. A special fixture, shown in Fig. 8, is used for internal grinding, the spindle being driven by a belt from a pulley on the end of the grinding wheel spindle. For surface grinding either the cross feed of the table may be employed or the table may be swung around so as to travel parallel with the plane of the wheel, in which case the longitudinal feed is used. It will be evident that, by means of this swivel slide, an unusual range and variety of movement is possible.

For cutter grinding and for various other kinds of grinding, especially upon small pieces, the movement of the table is made use of chiefly for placing the work convenient to the grinding wheel, the relative movement between the wheel and the work

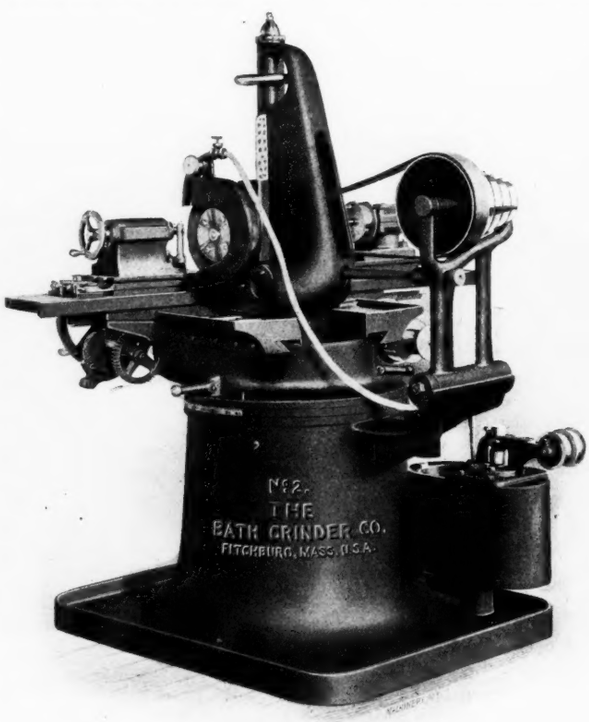


Fig. 2. Rear View of Bath Grinder.

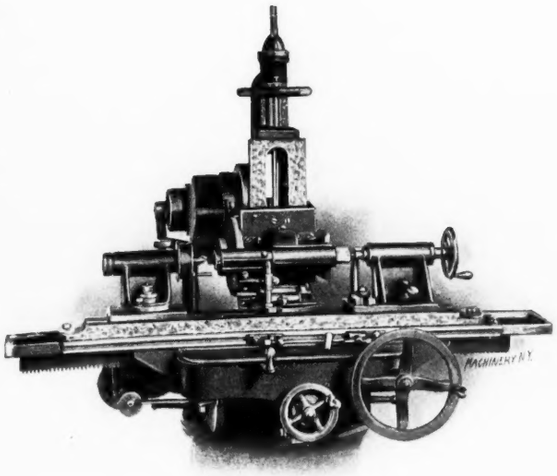


Fig. 3. Reamer Grinding. Method of Clearance Measurement.

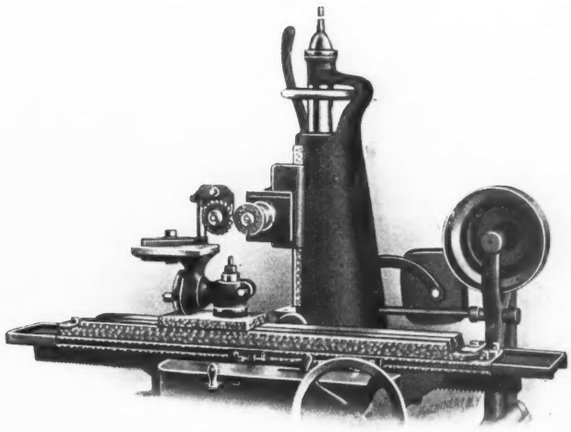


Fig. 4. Cutter Grinding, with Universal Holder and Tooth Rest Stand.

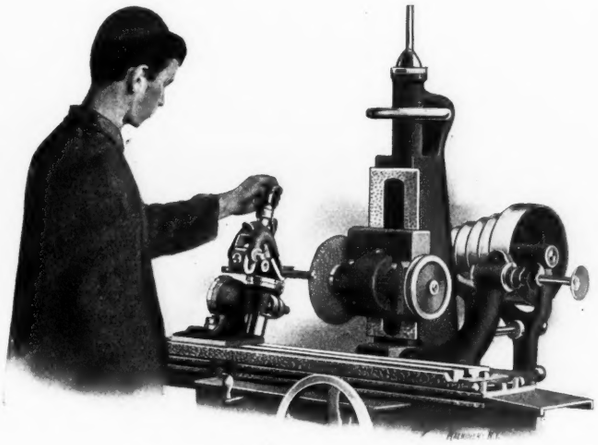


Fig. 5. Cutting off Hardened Tap by Hand.

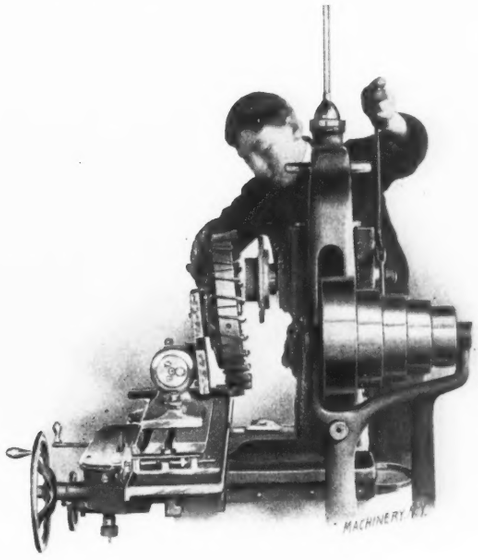


Fig. 6. Grinding an Inserted Tooth Face Milling Cutter.

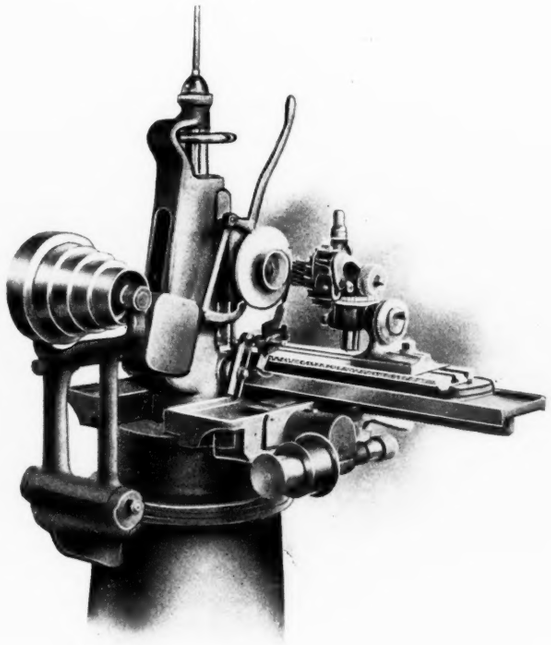


Fig. 7. Illustrating the Advantage of the Two-faced Grinding Wheel

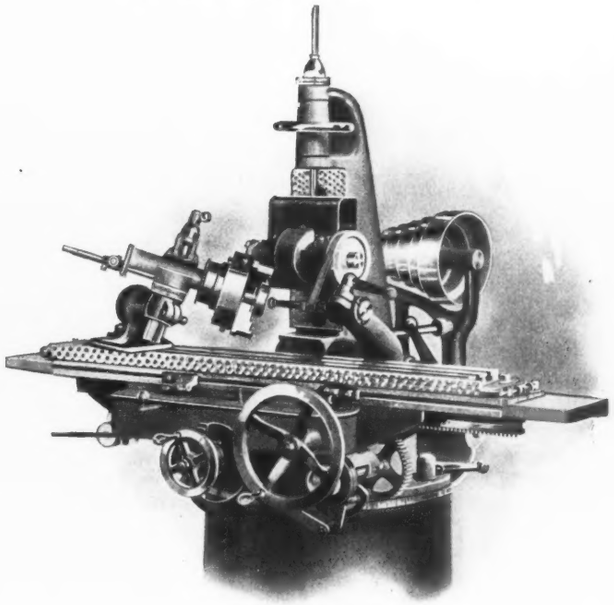


Fig. 8. Using the Internal Grinding Attachment.

being obtained, not by the travel of the work past the wheel in a horizontal plane, but by the vertical movement of the latter past the work, which is held stationary. In such cases a universal holder is employed, which is shown in several of the illustrations, and constitutes one of the distinguishing features of the machine. This holder has both horizontal and

vertical swivels with graduated movements. It is furnished with a V-vise and a horizontal vise which mounts on a flange plate. There is a T-slot in the bottom of the horizontal vise which permits the vise to be swiveled or adjusted on the flange plate, and clamped by a square-headed bolt, which passes through the stem of the flange plate into the T-slot in the vise, and is clamped underneath by a nut. The V-vise and flange plate stems both interchange to the same socket of holder, and in some operations they are used together or independently. If used together, the stem of the flange plate may be held in the V-vise.

Many styles of cutters can be ground by mounting on a plug screwed into the surface of the upper flange plate, and in such cases a plunger tooth rest is employed. This consists of a small pin inserted in a hole in the face of the flange, which is forced above the surface a short distance by a spring. The teeth bear against this pin in succession, and when the cutter is rotated each tooth depresses the pin, which springs back after the tooth has passed, forming a rest for that tooth.

Upon the front side of the upright frame is mounted the spindle head, which has a vertical movement. The position of the head is given by a graduated sliding bar, seen projecting at the top of the column. The graduations on this bar, together with those on a dial revolved by the handwheel which raises and lowers the spindle head, enable adjustments to be made within .001 inch. By this system clearances are obtained for all kinds of cutter and reamer grinding, and locations for various other operations. The spindle head may derive its vertical movement either from a screw or lever, as shown in Fig. 7. In one of the two sizes of the new grinder, the slide is counterbalanced for this movement, giving a quick, sensitive lever movement by hand. An adjustable gage stop, for gaging the length of stroke, is also provided in this machine. A great advantage claimed for the vertical slide is that it is about two-thirds shorter on the same length of tooth than the horizontal slide movement. Much less power also is required to move the counterbalanced vertical head than to move the table horizontally. The screw movement may be changed readily to the lever movement by the removal of a screw which connects the vertical head to the lifting screw. The hand lever is removed for cylindrical grinding on centers.

Fig. 3 shows the method of clearance measurement for reamer and cutter grinding used with this machine. In the illustration a 2½-inch reamer is being ground by the 8-inch disk face of the two-faced grinding wheel. When the spindle head is raised above or lowered below the center line to give clearance, an exact reading is obtained by means of the sliding bar graduated in sixteenths of an inch and the revolving dial which gives a reading of 0.001 movement. In this case a reading is obtained of ⅛ on the bar and 0.010 on the dial, which shows that the spindle was raised ⅛ and 0.010, the proper clearance when the reamer and wheel are of the given diameters.

In Fig. 7 the spiral tooth of an end mill is being ground by the disk face of the wheel, using the spring tooth rest. The end of the same end mill had previously been ground with the cup face of the emery wheel, and a plunger tooth rest. In this operation the mill is held in the holder by a taper bored sleeve which can be adjusted to the holder without any end play, and is revolved in the V-vise of the holder. A gage stop is not required for the end of the shank to abut against in grinding. The advantage of using the universal holder and the grinding wheel of two diameters is seen in that the cutter did not have to be removed from the holder or the position of the machine changed in passing from one to the other of the two operations just enumerated.

Fig. 4 shows the grinding of a convex cutter with the regular universal holder and the tooth rest stand. For this operation the holder is placed on the stem of the flange plate, bottom side upward. The tooth rest stand is then clamped to the bottom side of the holder, with the cutter placed in position for its radius to be ground, directly over the pivot point of the holder. For feeding and placing the cutter to the wheel the cross and longitudinal fine feed are used.

In Fig. 6 is shown a 14-inch inserted tooth face milling cutter of 24 teeth, which was ground in 55 seconds. As represented, the cutter is mounted on a stud screwed into the flange plate of the holder, and held in position by a nut and washer. As the cutter is mounted on the long end of the flange plate it can be raised or lowered by the pivotal swinging of the plate. The plunger tooth rest is used on the tooth being ground. The wheel is drawn vertically against the cutting edge of the tooth.

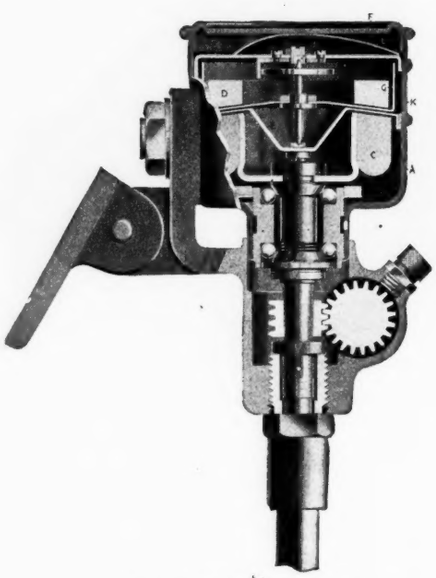
In Fig. 5 a hardened tap is represented being cut off by hand. The vertical pivot of the holder is clamped immovably, and the horizontal pivot is loosened, thus allowing the top portion of the holder to swing backward and forward.

In Fig. 8 the back side of an inserted tooth shaping tool is shown being ground. This figure also shows the internal grinding fixture in place. Many other difficult and interesting jobs of grinding may be performed by the Bath grinder besides those just described.

* * *

THE WARNER AUTO-METER.

The development of the automobile has made imperative some reliable instrument which shall indicate in direct reading at any moment the speed at which the machine is traveling. The Warner Instrument Co., Beloit, Wis., have designed a combined speed indicator and speed recorder, a sectional view of which is shown in the accompanying cut. The indicator is built on the principle of their well-known meter, used in machine shops for indicating cutting speeds of lathe and planer work, etc. A gear is mounted on the hub of the front wheel, which drives a pinion connected to a flexible shaft which leads to the instrument mounted in front of the operator where the readings can be easily seen. The flexible shaft drives the magnet, *C*, which revolves freely upon ball bearings. This magnet is not in any way connected with the indicating dial, save by the lines of magnetic force. The hair-spring, *H*,



Section of Warner Auto-meter.

holds the dial to the zero point, but the magnet when revolving has a tendency to draw the dial in the direction of its rotation. The hair-spring opposes this tendency, but the greater the rapidity of the magnet's rotations, the greater is the displacement of the dial. For instance, when the speed of the magnet doubles, the displacement is doubled, hence the dial is evenly graduated throughout its circumference, which is nearly 6 inches. This length gives ample space between the graduations, making them and the figure indicating "miles per hour" very legible. The worm and worm gear shown in the sectional view are for operating the odometer, the device for registering the number of miles traversed. These instruments are sent to the users carefully calibrated, and sealed so as to be absolutely dust-proof. An interesting feature is that internal parts are gold plated; this is not done for appearance sake, but to prevent corrosion.

LIFTING MAGNETS FOR HANDLING IRON AND STEEL.

We have received from the Electric Controller & Supply Co., Cleveland, O., the accompanying photographs showing some of the uses to which electric lifting magnets can be profitably put in plants where large quantities of iron and steel material are handled. The use of magnets for this purpose, while not new, is still so little known in the great majority of shops that it possesses the feature of novelty for most of our readers. It is claimed that wherever iron or steel is handled in quantities by means of cranes, an electromagnet should effect economies in time and labor sufficient to pay for itself in from one to six months. This is borne out by the experience of the Illinois Steel Co., who use fourteen magnets in their South Chicago shops alone, where they have found the economy in time and labor so marked that they have decided to use them wherever possible throughout their works. These magnets have been found particularly useful in steel mills, jobbing houses, safe works, foundries, and other places where iron or steel pieces have to be handled in large quantities, in which cases the labor cost of attendance is a considerable item.

The magnet is suspended from the hook of the crane, a direct current of any common voltage being employed to energize it, transmitted through a flexible twin conductor cable; a small switch operated by the crane attendant is usually the only additional apparatus necessary. The consumption of current is small, being from one to twelve amperes, according to the service for which the magnet is designed. In this connection it may be mentioned that a single design of magnet is not adapted to handling the full range of material, such as pig iron, scrap, rivets, bolts, ingots, blooms, slabs, billets, bars, plates, rolls, structural shapes, pipe, etc., but on the contrary the magnets may be designed to meet the form of material to be handled. There is a wide difference, for instance, in the design of a magnet for lifting ingots or blooms, and one adapted to the handling of thin plates. A magnet which would handle five tons in the form of an ingot might not safely handle 500 pounds in the form of thin plates. It is therefore necessary to know in each case the operating conditions to which these devices are to be applied in order to insure an economical and safe design. An advantage of considerable importance in many places is the reduction of head room necessary when using the ordinary hook and chain. With the lifting magnets this reduction is considerable, especially on material of considerable width, such as plates. This enables piles of plates to be carried higher in storerooms than is possible with the chain, and another advantage is that no space around the piles is necessary for the men superintending the piling, as is the case when using chains. This has been found to be a very important consideration in storage yards of steel mills, where the alleys left between the piles of material absorb a considerable percentage of the total available space.

In the handling of material the magnet is lowered upon it and the switch closed, thus causing it to attract and hold it firmly while being hoisted by the crane and transported to the desired point. Simply opening the switch instantly releases it. The natural objection of those unfamiliar with the operation of lifting magnets is the apparent risk of accident. The Electric Controller & Supply Co. inform us that in their experience with scores of lifting magnets in successful operation, they have yet to learn of a single accident which has occurred through their use, while on the other hand accidents due to the slipping or breaking of hooks and chains are known to be of frequent occurrence. The magnets made by this concern are tested with a load from four to five times as heavy as that specified, which should give an ample factor of safety.

The magnet shown in Figs. 1, 2 and 3 is 35 inches in diameter and costs for current about 6 cents per hour to operate continuously, this figure being based on a cost of 3 cents per kilowatt for current, and on the supposition that the current will be on the magnet for 60 per cent of the time. Fig. 1 shows the magnet lifting three kegs of cotters, with the heads on the kegs. Fig. 2 shows the same magnet lifting the contents of the kegs in the shape of loose cotters, the magnet gathering up nearly every cotter contained in the three kegs. In Fig. 1 several nails will be noticed standing out. These were thrown on the keg by some of the spectators and stayed there standing straight out, showing that the whole mass was highly magnetized; but when released the cotters immediately and entirely lost their magnetism, and the same applies to all soft steel or iron. In Fig. 3 the magnet is shown lifting twelve pigs of pig-iron, each weighing approximately 75 pounds. These were lifted from a pile upon the floor.

Fig. 1. Magnet Lifting three Kegs of Cotters; Heads on Kegs.

Fig. 2. Magnet Lifting Contents of three Kegs, in Loose Form.

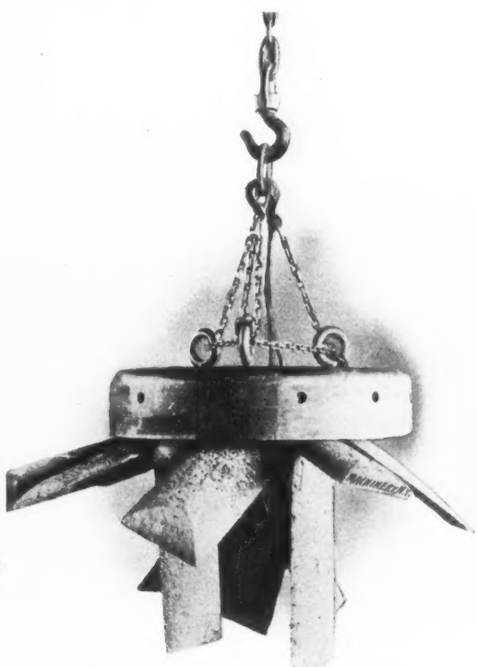


Fig. 3. Magnet Lifting twelve Pigs of Pig Iron Weighing 900 pounds.

The design of this type of magnet is the result of a series of experiments to obtain the most efficient design for the handling of iron and steel objects of irregular shapes in blocks. The lower end of the center pole is not in the same plane or level as the outer pole, but when the magnet is set down on the floor, for illustration, the center pole does not touch it within 2½ or 3 inches. In this way an intense mag-

netic field is obtained which concentrates the load around the center pole. The lifting magnet, shown in Figs. 1, 2 and 3, weighs from 1,500 to 1,700 pounds equipped complete with chains for attaching it to the crane.

* * *

THE USE OF DISTINCTIVE COLORS.

OSCAR E. PERRIGO.

There are some things which appeal to the sense of sight much more readily than to any other faculty, and seem to force themselves upon our understanding whether we pay much attention to them or not. Not only this, but they produce a lasting impression that is not easily gotten rid of. Notable among these is the perception of *colors*.

If we undertake to direct a friend to a certain house, we may remember that it is between two certain streets, or that it is just beyond a certain street, but the idea we are most likely to be sure of is that it is a red house, or a brown house,

Fig. 4. Magnet Lifting Blooms; weight, 1700 pounds.

or a yellow house, etc., for we can nearly always remember the *color*. The collector calls to collect a bill. The busy man at the desk glances at the accumulation of them in a clip and impatiently says: "I am very busy to-day and can't stop to look for your bill just now; call again." But the collector says: "You don't have to look much, it is that red one there." The red bill is withdrawn and the matter quickly adjusted. It was the *color* that did the business. And so it goes on, and many persons who will run over a lot of different blanks, all of one color, without finding the right one for some time, will readily select the right one if it is printed on a paper of distinctive color. Such being the case with a very large majority of persons, we may profitably make use of this peculiarity in formulating and practicing some of the necessary systems for organizing the daily routine of clerical and mechanical work in the office and shop.

First, let us consider the use of distinctive colors for office or shop blanks. In the column below, the first nine are the preferred colors. If these are not sufficient for the number of blanks wanted, those following may be resorted to. There are other shades which the printer can show us, but the idea is to get ordinary and well-known colors, as well as those of as much difference in color as possible.

White.	Yellow.	Dark Green.
Manila.	Pink.	Orange.
Light Red.	Drab.	Rose.
Light Blue.	Lavender.	Gray.
Light Green.	Dark Red.	Chocolate.
	Dark Blue.	

This gives us, as will be seen, nine light colors, which are preferred because the printed matter shows up plainly on these colors of paper, and seven less desirable, but perfectly practical tints, if the number of blanks requires them. The less desirable tints may also be used for blanks that are seldom needed. Where the blanks are used in several departments the colors in local use should be as dissimilar as possible, while a similar assortment of colors may be used for local blanks in the other departments.

The men through whose hands these blanks pass will soon become accustomed to their distinctive colors and speak of them, not by their printed headings, but as "a red blank" or "a blue ticket," etc., and their color will almost invariably secure their use for the purpose intended, much more certainly than any amount of printing on their face. In sorting out the mass of blanks as they come into the office of the superintendent, the timekeeper, or the foreman, the work can be done in about one-fourth of the time that is required when all the blanks are of one color.

Again, distinctive colors can be used for patterns, by which core prints are distinguished from the parts of the pattern to come out in metal, as well as to indicate the kind of metal of which the castings are to be made. The system is as follows: All core prints are red; all patterns for the gray iron foundry are black; those for the malleable iron foundry are brown; those for steel castings are blue; for brass castings yellow, and for bronze castings orange.

In the shop where this system was put in practice the patterns and core prints had formerly been made of any color to suit the fancy of the particular patternmaker who made them, black, of course, predominating. The unpleasant as well as expensive result was that patterns for gray iron castings were liable to go to the malleable iron foundry, and *vice versa*, or patterns for the malleable iron foundry would go to the steel foundry, and a great many mistakes were made. With the advent of distinctive colors came such a change that in thirteen years of practice not a single pattern went to the wrong foundry, so far as was known.

In the pattern loft the different colors may be made use of by painting the stripes in front of the shelves of different colors to distinguish the various machines to which the patterns belong, afterward lettering them for the different sizes or types. For instance, in a shop building machine tools, we may use the colors as follows: Blue for lathe patterns; white for planer patterns; green for drill patterns; yellow for milling machine patterns; light red for slotter patterns, and dark red for shaper patterns, and so on as may seem most convenient

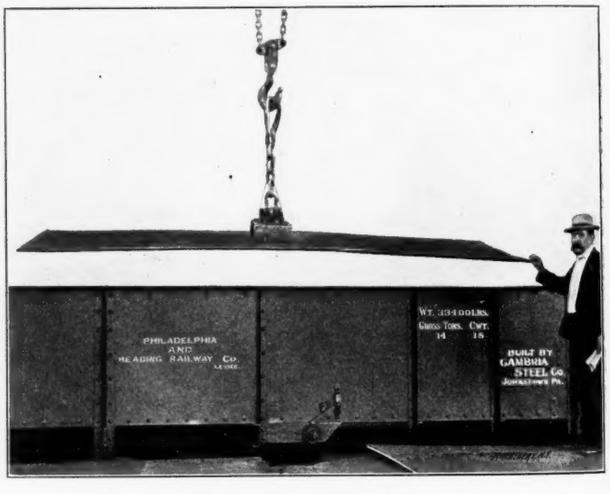


Fig. 5. Handling Steel Plates.

or appropriate. An inexperienced boy or man, or one not acquainted with the location of the patterns may be sent to the pattern loft after a pattern, and by giving him the color of the shelves where the particular group of patterns may be found much time will be saved, even though the different series of shelves may be numbered and lettered.

In making the colors herein mentioned the following *dry* colors are mixed with shellac varnish, namely: Lamp black, vermillion, Prussian blue, burnt umber and chrome yellow. The Prussian blue is made lighter by adding a little *dry* white lead. The orange is made by adding a little red to the chrome yellow. If we desire to use green it may be made with *dry* chrome green, light or medium shade.

In mixing two colors together they should first be dissolved separately in shellac varnish, and then mixed when in a liquid state.

NINETY-SIX INCH SELLERS PLANER WITH AIR-OPERATED FRICTION CLUTCHES.

The new planer by Wm. Sellers & Co., Inc., Philadelphia Pa., shown in Fig. 1, is the one alluded to editorially in MACHINERY for last June. While an exhibition of this interesting machine tool was given before a number of engineers on April 30 last, the description of it has just been given out for publication.

The planer is intended for work not exceeding 96 inches wide, 96 inches high and 20 feet long. It is equipped with two cutting tools on the cross rail and one on each of the housings. Each of the two saddles has its own feed motion, independently adjustable in direction and amount. Each has also its own stopping and starting device, but the planer is so arranged that all of these can be thrown out of action or into action simultaneously by the motion of a hand lever, manipulated from either side of the machine. The table has a constant return speed of 80 feet a minute, and a variable cutting speed of from 15 feet to 45 feet a minute. The table is supported in one flat and one V-bearing, which are provided with a forced system of lubrication by means of a pump with circulating pipe system, oil tank and filters. The V-bearing has four surfaces, two forming a V of large angle, sufficiently inclined to guide the table under ordinary circumstances, but having the minimum wedging action. The other two surfaces are nearly vertical. These do not bear under ordinary circumstances, but are ready to resist side cuts which are sufficiently heavy to slide the table up on the V, so as to bring the vertical surfaces in contact. This arrangement permits the table to run lightly under ordinary work, but prevents it from lifting under any condition of heavy side cutting. The table rack of 2¾-inch pitch and 10-inch face is driven by a spiral pinion of 5 threads.

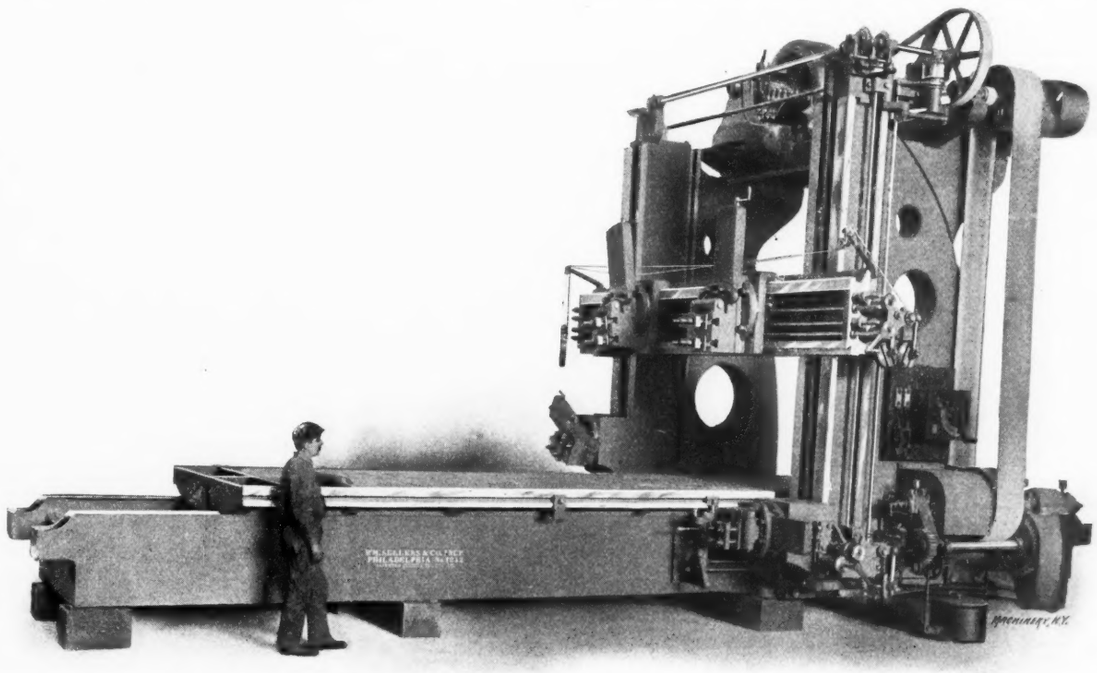


Fig. 1. Sellers Planer, with Air-operated Clutches.

The driving and reversing mechanism is shown diagrammatically in Fig. 2. *P* represents the shaft which carries the spiral pinion driving the table. On its outer end is mounted a spur wheel, *O*, driven by the spiral pinion *N* on the pulley shaft. The driving pulley *A*, which is loose on the pulley shaft *K*, runs continuously and in the same direction while the planer is in operation. On the hub of the pulley *A* is a pinion *B* driven through a reducing train of wheels, *C*, *D*, *E* and *F*, to a loose wheel *G* mounted likewise on the pulley shaft. It is evident that the wheel *G* will run in the opposite direction to the pulley *A*, and at a reduced speed depending upon the ratio of the gears in the train. The pulley *A* is turned on one side to form the female half of a conical friction clutch. The wheel *G* is turned on both sides in a similar manner. *J* and *M* are two conical male elements bolted together and forming an air-tight cylinder free to move back and forth on the disk *H*, which is keyed and pinned to the shaft *K* and forms a piston in the cylinder. In order to compel the shaft to rotate with the friction clutch the head of the cylinder *J* is provided with notches into which project teeth on the surface of the piston *H*, as shown in the view above *J H*, in Fig. 2. These form a jaw clutch and permit end movement, while they compel the parts to rotate together. Air admitted to one end of the cylinder through the center of the shaft *K*, between the parts *H* and *M*, for example, will cause the cylinder to move in the direction of the pulley *A* and to press the friction cone against the pulley so as to cause the clutch to rotate with the pulley. This movement will be transmitted through the piston *H* by the clutch teeth, and cause the shaft to rotate in the same direction, which produces a return movement of the table. Admitting air to the opposite end of the shaft will cause the clutch *J* to engage with the wheel *G* and to force the latter against the stationary clutch *L*, which is keyed to the shaft. The wheel *G* will then drive the shaft through both of the clutches, one on either side, in the proper direction for cutting at a speed which may be varied by changing the gears *E* and *D*. These are mounted on split bushings with conical holes, which permit the gears to be shifted with the minimum amount of trouble.

In the operation of the planer the table stops move an air valve which admits compressed air alternately to the opposite ends of the cylinder, and by regulating the velocity of the admission the speed of reverse can be nicely gaged. It is arranged so that the table is brought to rest promptly and started up in the opposite direction without shock. There is no reversal of high-speed pulleys and the flywheel action of the parts whose motion is reversed, owing to their relatively small size, is greatly reduced. The pulley *A* may be driven through a countershaft in the ordinary manner, or from a motor as in the present instance, where the 50 H. P. motor is mounted on a cast-iron platform carried on brackets from the housings, the platform serving as a cross girt between the housings. The motor drives by horizontal belt to a countershaft, which in turn drives the pulley shaft at the base of the housing.

A separate belt is used to actuate the lifting gear and drive the feed motion. The latter is accomplished through a posi-

tive motion clutch, which is stopped and started at each reversal of the table. The movement of the table dogs not only actuates the air valve, but it trips the escapement train in the feed motion, and allows it to make half a revolution. This gives a half turn to each of the crank disks, transmitted from the clutch through a square shaft on the side of the housing, by bevels to a horizontal shaft driving a similar square shaft on the left-hand housing. Each of these disks having a half turn at each reverse, the amount of feed is determined by the position of the crank. The work done by the dogs, it will be seen, is of the lightest character, and the shifting by hand is also easily accomplished.

A novel feature of the side heads is that they are lifted by the same screws which carry the cross rail. These screws are stationary under ordinary circumstances, and the heads are raised and lowered by rotating the nuts. It is found in practice that this form of clutch releases and engages with great regularity and very promptly, so that the stroke of the planer is remarkably uniform, the reverse always taking place at the same point. The overrun at the beginning of the stroke is only sufficient to allow the feed to act.

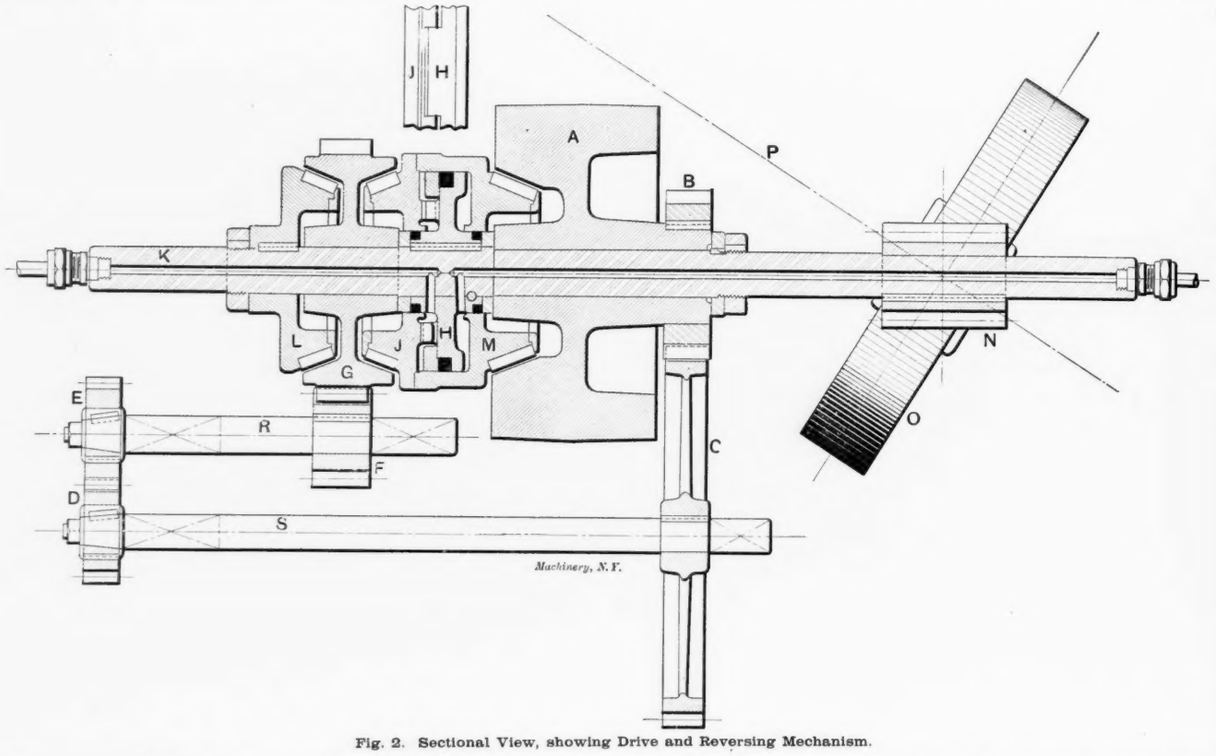


Fig. 2. Sectional View, showing Drive and Reversing Mechanism.

Another novel feature about this planer is the manner in which the cross rail is secured to the uprights. The back of the cross rail between the uprights is extended in a rectangular form, with two vertical surfaces fitted with gibs to the inside surfaces of the uprights or housings. A flange on the back of the cross rail extension is provided with bolts working in T-slots in the inner faces of the uprights. Tightening these bolts draws the uprights against the crossrail, which is also secured to the face of the uprights in the ordinary manner. This method of bolting brings into play the strength of the housing to resist the torsion of the cross rail, and at the same time the cross rail stiffens the housing against the twisting action of the side heads. The effect is an enormous increase in the strength of the combined parts, so that unusually heavy cuts can be carried.

In some 54-inch planers of this construction, two cuts of 60,000 pounds each were taken in steel, without any perceptible spring of the cross rail, although the latter was scarcely larger than what is usually provided for a planer of that width.

The total weight of the planer is about 60 tons.

* * *

NEW TRADE MARK BILL.

A new bill has been introduced in the House of Representatives, with regard to the revision and modification of the laws relating to trade-marks. The four items that appeal most to manufacturers are: Reduction of the registration fee from $25 to $10; the unrestricted registration of all marks that have been in use ten years; the extension of registration to marks used in interstate commerce only, and the appeal to the Court of Appeals in cases that are rejected by the Commissioner. From a report of this bill by Mr. Bonynge, of the Committee of Patents, we quote the following:

"In the past there has been considerable complaint in regard to what could be registered under the existing law as a trade-mark. Much of the time of the committee in the hearing of the bill has been consumed in a discussion upon this particular feature of the legislation. The proposed bill will permit the registration of all marks which could, under the common law as expounded by the courts, be the subject of a trade-mark and become the exclusive property of the party using the same as his trade-mark, and a proviso has been added permitting all marks that have been in actual use as trade-marks for a period of ten years to be registered.

When the application for registration is filed, the bill provides for an examination of the mark offered. If upon such examination the application is refused, notice is given to the applicant in order that he may appeal, if he so desires, from the decision. If, on the other hand, the examination discloses that the mark is entitled to registration, the act provides that the Commissioner shall cause it to be published at least once in the Official Gazette of the Patent Office. The purpose of this publication is apparent. Owners of trade-marks ought not to have their rights to the use of a trade-mark jeopardized by the registration of similar trade-marks by other parties not entitled to the use of the same. The right to the use of a trade-mark is perpetual, so long as the same is actually used in commerce.

By another section of the bill provision is made for designating registered trade-marks by printing under the trade-mark the fact that it is registered, as is done in the cases of patents, so that any person who imitates or counterfeits a trade mark will not do so in ignorance.

* * *

The underground railway system of London is operated only in part by electricity, steam engines still being employed in a number of the tubes. When the electrification of all the subways is completed, as planned, one will be able to travel sixty miles underground without running over the same piece of track.

BULLARD THIRTY-SIX INCH VERTICAL TURRET LATHE.

The new vertical boring and turning mill brought out by the Bullard Machine Tool Co., Bridgeport, Conn., or as it is styled by the makers, the vertical turret lathe, is the result of considerable experimenting on their part. It is especially designed for the handling of heavy faceplate work, which, with a horizontal faceplate lathe, would require considerable time in chucking. The vertical construction has, besides the gain of time in setting, various other points of superiority for such work over the horizontal lathe, and the present patented design is intended to take the fullest advantage of these natural superiorities, and also as far as possible to embody in the vertical mill points which usually are seen only in horizontal lathes. As shown in the front view, Fig. 1, the lathe has a five-sided turret on a turret slide, and also a side head which has vertical and cross power feed, and which is so arranged as to interfere in no way with the turret when both heads are being operated jointly on work of either large or small diameter. A

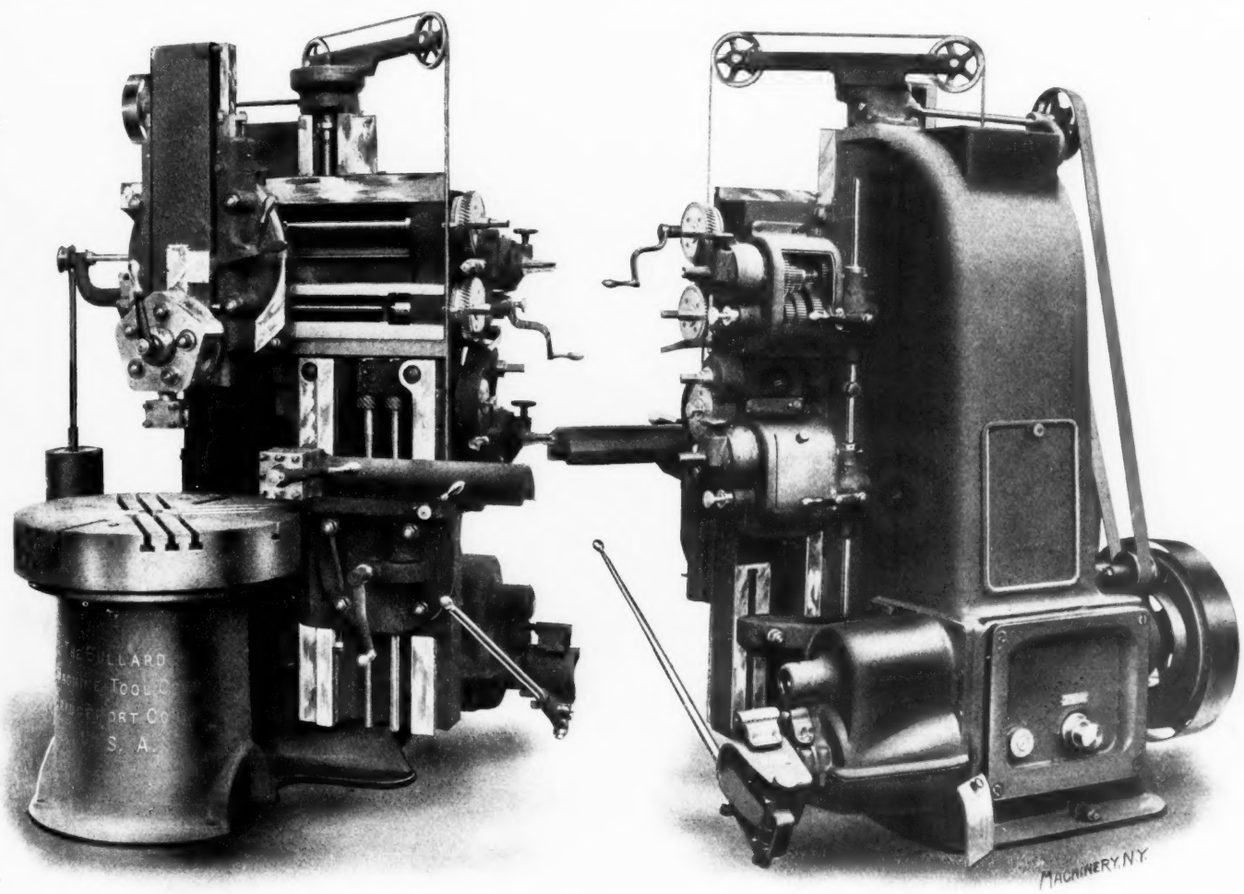


Fig. 1. A New Bullard Boring and Turning Mill which the Manufacturers style a "Vertical Turret Lathe."

mill with these features is very similar to a regulation horizontal turret lathe, as may be seen by inspection of Fig. 3, which represents the machine turned over on its back.

The lathe has a capacity of 36 inches in diameter and 24 inches in height. The table is 34 inches diameter and is driven by an internal spur gear having a diameter nearly that of the table. The latter is carried by a spindle having a self-centering tendency, due to a large angular thrust bearing, side strains being taken by vertical bearings of large proportions. The weight of the table and spindle, as well as the weight of the work upon the table, tend to preserve rather than destroy alignment, in which is evident a point of superiority over the horizontal faceplate lathe with its heavy overhanging piece of work.

The turret head has both cross and vertical feeds, and may be swiveled to 45 degrees either side of the center for taper boring and turning. The slide is square locked throughout, all adjustments for wear being made by taper wedges without the use of any loose gibs. The holes in the five faces of the turret are 2½ inches in diameter, the inscribed circle to which the faces of the turret are tangent being 10 inches in diameter. The turret faces are square with the table, and tapped holes are provided for attaching special tool holders. The vertical and side heads are entirely independent in their movement, both as to direction and amount of feed. The vertical head will face 36 inches, and has a vertical and angular movement of 26 inches. The turret is of such a construction that either single-point tools or simple formed tools may be used to advantage. Binder plugs are provided in the turret, having a double grip on the tool holder shank.

The side head has a vertical movement of 28 inches, and a horizontal and angular movement of 15 inches. It may be set to an angle of 40 degrees either side of the horizontal. It carries a four-faced turret tool holder, thus obviating the necessity of frequent change of tools. In this, 1-inch by 1¾-inch tool steel may be used. Long boring bars and extended tool holders are not required in the vertical turret, when the side head is used. The latter possesses not only the points of vantage of the carriage of the horizontal machine, as the cross and vertical feeds, but by its swiveling, angular facing through a wide range may be done. The machine may be supplied without side head if desired, in which form it has a capacity of 41 inches in diameter.

The arrangement of the feed and speed gears is seen from the back view of the machine given in Fig. 2. Fifteen changes of table speeds, ranging in geometrical progression, are mechanically obtained from a single-speed driving pulley through a speed box containing powerful self-adjusting friction clutches. Change to any speed desired is obtained by a lever conveniently placed at the front of the tool. By lifting this same lever the table is stopped at any desired point by means of a direct-acting brake which operates at points intermediate between speeds, without stopping the driving pulley.

The feeds for both heads are positive, and have eight changes ranging from 1-96 to ½ inch in all directions. Feed changes

for either head are obtained by turning a star-wheel, the amount per revolution being indicated on a direct-reading index plate on each feed box; change from vertical to cross feed or *vice versa* is obtained by engaging a centrally located drop worm with the worm gears on the ends of the feed rods, thus eliminating the pull gears often seen on feed rods. Safety points have been so arranged in the feeds that carelessly permitting the heads to run together results in no damage to the feed works. This device is said to in no way weaken the feeds; it is not in use when the threading attachment is engaged. The lubricating system is very complete. The headstock speed

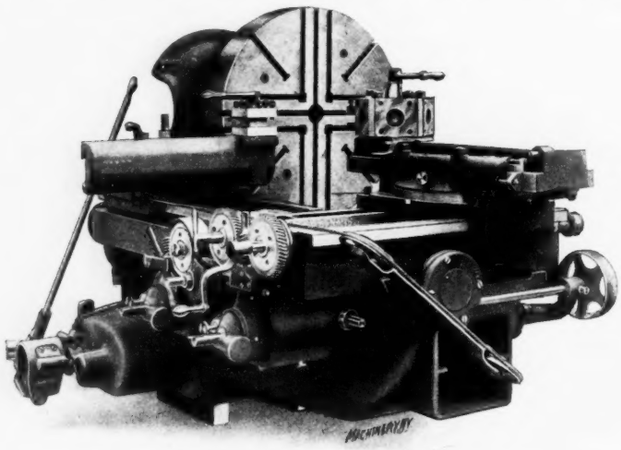


Fig. 2. Bullard Vertical Lathe on its Back, showing resemblance to Horizontal Lathe.

box and the feed boxes are entirely encased, and the gearing runs in a constant bath of oil. All high-speed journals run in bronze bearings and are self-oiling. The table spindle is constantly immersed in oil, and sight feed lubricating cups are so placed that the oil level may be maintained.

The cross and side rails in this machine are a unit, and have a vertical adjustment by power of 12 inches. A much greater efficiency for the vertical slide is thus available on work of various lengths. The side rail may, of course, be removed if it is desired to use the machine without the side head. The guide bearings for saddles are narrow, the ratio of length to width being great to prevent tilting and binding of the heads.

The driving pulley is 24 inches in diameter for a 4-inch double belt. The countershaft has one tight and one loose pulley, 14 inches in diameter for a 4½-inch belt, and should run 420 R. P. M. A 7½-H. P. constant speed motor may be mounted on a bracket at the side or rear of the machine, and connected up by a belt, gearing, or chain. If used, its speed should not exceed 1,200 R. P. M. A thread-cutting attachment may be used on the vertical head if desired. The machine is self-contained, and is very rigid, box sections being used. It is an efficient machine for the use of the new tool steels.

* * *

REINFORCED CONCRETE PILES.

Recently 580 reinforced concrete piles were driven, in making the foundations of the new railway station at Hamburg. The soil on which the station is built varies considerably, but is composed chiefly of sand, marl, and clay, and it carries a great deal of water. The piles were about 14 inches square and 23 feet long, and were each reinforced with four 1-inch diameter round bars, which were tied together at intervals by wire. After being made, the piles were permitted to remain in the molds for three days, after which they were removed and allowed to harden for two weeks before being driven. They were shod with iron and driven by a pile-driver, with a tup weighing 8,000 pounds, having a drop of 4 feet. The safe load was calculated by the following formula of Brix:

$$p = \frac{h\ Q^2\ 3}{2\ e\ (Q+3)^2},$$

where p = safe load in kilograms; h = height of fall in centimeters; Q = weight of hammer in kilograms; e = the amount of penetration for the last blow of the hammer in centimeters, and 2 is a coefficient of safety.

NEW STORE OF HAMMACHER, SCHLEMMER & COMPANY.

The long-established firm of Hammacher, Schlemmer & Co., dealers in tools and supplies for manufacturing establishments and also dealers in hardware, now occupy their new and commodious building at Fourth Avenue and 13th Street, near Union Square, New York, as already announced in our advertising columns. Since the formation of the original company their home has heretofore been on the Bowery, and for many years in the familiar store at 209 Bowery, New York. In their new home they have considerably more room than before, and their quarters are more spacious, attractive and better adapted to the growing needs of the firm in every way than was the old building. The new structure is seven stories high, of steel frame construction, finished in combination brick and stone, and has a floor space aggregating about 40,000 square feet, with an opportunity for future enlargement. The division of the building is as follows: First floor, devoted to retail sales room; second floor, to main offices; third, to shipping and receiving departments; fourth, fifth, sixth and seventh floors and basement, to stock room. The building fronts on Fourth Avenue and has an L running to 13th Street, which is used for private offices, stock rooms, cloak rooms, lavatories, elevators, etc.

William Schlemmer, President and General Manager.

While Hammacher, Schlemmer & Co. are probably better known to our readers as dealers in tools than in any other capacity, the most important branch of their business consists in supplying manufacturing plants, especially those in metal working lines, with manufacturers' supplies of various kinds in large quantities. They carry six distinct main lines of goods, consisting of general factory supplies, tools for all trades, bolts, screws and nuts, cabinet hardware, builders' hardware and piano supplies. They deal with manufacturers and consumers direct, not selling to jobbers except in the case of certain specialties which they control. Their salesmen travel throughout the United States east of the Mississippi, and through Canada. An inventory of stock has shown from 8,000 to 10,000 items of different kinds of articles and from 70,000 to 80,000 total items, counting different sizes of the same article. These items, as a matter of course, are mainly in staple lines for which there is constant demand, but they have always had to supply many special things not usually carried by supply houses.

Numerous catalogues and circulars are published for the purpose of listing the stock in convenient form for different classes of purchasers. About 150 catalogues or circulars are in use. The tool catalogue, which many of our readers possess, contains 800 pages; one of bolts, screws and supplies, 193 pages; one of builders' hardware, 283 pages; one of cabinet hardware, 407 pages. There is a special circular, devoted exclusively to planes, containing 43 pages, and many other classes of supplies, tools or hardware have separate circulars, of which the following items, each the subject of a circular, will give an idea:

Tool Chests; Clamps, Hand Screws, etc.; Dowels, Birch, etc.; Handles (File, etc.); Files and Rasps; Leather Fillets for Patternmakers; Hollow Setscrews; Outfits of Tools for Home Use; Rivets and Burrs; Screwdrivers; Spring Cotters; Tools of all kinds; vises of all kinds; Miter Boxes; Imported French Band Saws.

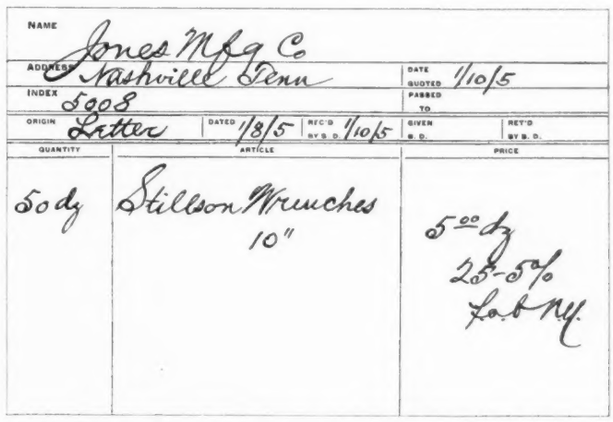
In the retail store half the area is devoted to hardware and the other half to tools. All the shelving, drawers, etc., were built especially to order to fit the stock carried, and the plan followed in laying these out was to take samples of the goods to go in a certain drawer for example, place them on a sheet of paper the size of the drawer, and mark around each piece showing the place taken. This paper then served as a guide to the cabinet maker in locating partitions. The cabinet work is in oak and is handsomely executed. The retail store is in communication with the other departments by means of dumb-waiters, pneumatic tubes for carrying orders, etc., and telephones, so that if a customer wishes a larger quantity of anything than is carried in the store, it can easily be sent down from the stock room. A label on the side of each drawer tells in what department the surplus stock is carried.

In the stock rooms where the orders are filled it has been necessary to work up a system for taking care of the orders that is as nearly automatic as possible. In filling orders for small parts it might happen, for instance, that one or more of the items was not in stock at the time the order was placed, and if the stockkeeper deferred making up the balance of the

New Store of Hammacher, Schlemmer & Co., Dealers in Tools and Supplies.

order until the missing stock was received, he might at that time be no better off because some of the other items might not be on hand. To avoid this there are drawers and bins arranged in a department where the material for all incomplete orders is placed and remains until the balance of the stock is received, unless the customer wishes the incomplete order shipped first and the balance later.

In the main offices, also, the system by which the business is kept track of, both on the outside and inside, is as nearly automatic as possible. This matter of keeping track of inquiries is a problem in itself which every dealer and manufacturer has to work out in one way or another. The system used in this store has been in operation for several years with satisfaction, and it will be of interest to refer to it briefly. "Quotation Tickets" are employed, one of which is shown on a reduced scale in Fig. 3. Let it be supposed that an inquiry has come in for a price on 50 dozen 10-inch Stillson wrenches from the Jones Mfg. Co., Nashville, Tenn. The name of the firm and the address are entered as shown. The inquiry has come by letter, as indicated under the heading "Origin" at the left, followed by the date the inquiry was received. A clerk in the sales department enters the date the inquiry is received by him if he is to make the quotation, and he also fills in the date on which the quotation was made, and under the heading "Price," the price quoted the Jones Mfg. Co. In case a card must be passed to the buying department to secure data for the quotation, the blank space to the right of "Given B. D." is filled in with the date on which the card is handed in to the department and when the card is returned they fill in the date opposite "Ret'd by B. D." This shows at once where a delay has occurred. If it is necessary to pass the inquiry to other hands to be followed up, as for example, to the export department; or if the inquiry has come through a salesman and it is desired that he should attend to the matter, the name of the


NAME Jones Mfg Co
ADDRESS Nashville Tenn
DATE QUOTED 1/10/5
INDEX 5908
PASSED TO
ORIGIN Letter
DATED 1/8/5
REC'D BY B. D. 1/10/5
GIVEN B. D.
RET'D BY B. D.

QUANTITY	ARTICLE	PRICE
50 dz	Stillson Wrenches 10"	5.00 dz 25-5% f.o.b. NY

Quotation Ticket for keeping a Record of Inquiries and Quotations.

person receiving the card would be filled in opposite the heading "Passed to," and when the person, or department, is through with it the date of return will be entered in the space marked "Ret'd." When the quotation is finally made or the inquiry followed up, the card is placed on file under the index number corresponding to the Jones Mfg. Co. Provision is made, in replying to an inquiry, for following it up at a later specified date, by stamping on a carbon copy of the reply, which is placed in a special file, the date at which the matter is to be taken up. The volume of business done is so large that it is found advisable to give each customer a number and to have that number stand for that customer in all office records. The quotation cards filed under each number thus make a complete history of quotations furnished customers, where they can be referred to instantly.

The firm of Hammacher, Schlemmer & Co. began business some time prior to 1848, at 221 Bowery, moving in 1857 to 209 Bowery, where they remained until October of last year, when they moved to their new home at Fourth Avenue. Mr. William Schlemmer, the president and general manager of the business, came to the concern as a boy in 1853 and has never engaged in any other enterprise. He was born in Westphalia, Germany, of German Lutheran parentage, in 1841. He is foresighted and an indefatigable worker, with great persistency of purpose. In 1893 a corporation was formed under the New Jersey law, but the name of the firm remained unchanged.

* * *

The recently completed East Boston tunnel, extending from Maverick Square, East Boston, to Court Street, Boston, is 7,450 feet long, mostly under water. At its deepest point the tunnel's bottom is 40 feet below the 40-foot dredging line at the bottom of the harbor. The tunnel has two tracks, and is noteworthy for its liberal size and the absence of short curves. The tunnel walls are of concrete, which is reinforced at a few special points by steel tie rods. The electric power is conveyed, not by the third rail as in the New York Subway, but through a trolley wire. Experiments are being carried on looking to the replacement of the trolley wheel by some other form of a collector which will cost less for maintenance, various systems used abroad which replace the trolley wheel by a sliding bar of aluminum or other metal at right angles to the trolley wire being well thought of. One of the most interesting features of the tunnel is its lighting, there being over 600 incandescent lamps in service, spaced 12 feet apart, in three rows, throughout the tunnel. The building of the tunnel took about four years and seven months.

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Entered at the Post-Office in New York City as Second-Class Mail Matter.

MACHINERY

DESIGN—CONSTRUCTION—OPERATION.

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

66-70 WEST BROADWAY, NEW YORK CITY.

LESTER G. FRENCH, Editor.
FRED E. ROGERS, Associate Editor.

The receipt of a subscription is acknowledged by sending the current issue. Remittances should be made to THE INDUSTRIAL PRESS, and not to the Editors. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Single copies can be obtained through any newsdealer.

We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

MARCH, 1905.

NET CIRCULATION FOR FEBRUARY, 1905,—23,164 COPIES.

MACHINERY is published in four editions. The practical work of the shop is thoroughly covered in the Shop Edition—$1.00 a year, comprising more than 430 reading pages. The Engineering Edition—$2.00 a year—contains all the matter in the Shop Edition and about 250 pages a year of additional matter, which includes a complete review of mechanical literature, and forty-eight 6 x 9 data sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering, but is printed on thin paper for transmission abroad. RAILWAY MACHINERY, $2.00 a year, is a special edition, including a variety of matter for railway shop work—same size as Engineering and same number of data sheets.

An illustration of the difficulty sometimes experienced in getting work done right is given in the January issue of *The Locomotive*. It shows the disposition manifested by some men to expend much energy to conceal rascality in the erection of work, which, if properly directed in the first place, would have made a first-class job. In the inspection of a steam plant by one of the inspectors of the Hartford Steam Boiler Inspection and Insurance Company, it was found that the bolts used to join the pipe flanges were in some cases too short, the ends of the bolts lacking a number of threads of projecting through the nuts. The inspector ordered that the short bolts be removed and new bolts be put in, giving a full length of thread to all the nuts. The piping ran across the upper part of the boiler room where the air was exceedingly hot and uncomfortable, hence the task of replacing the bolts was not a very pleasant one. Instead of replacing the faulty bolts, the rascally workman sawed short pieces from other bolts and screwed them into the nuts, thus giving them the appearance of full-thread bolts, and it was only by close inspection that the fraud was discovered. Here apparently is a case where a workman, to save himself a little discomfort, was dishonest enough to conceal a botched job, which perhaps endangered the lives of the power plant employes. In general, it may be laid down as a principle that no man who is not honest can make a first-class workman. The dishonest or deceitful mechanic perhaps could not do close work because the necessary love for truth and accuracy is not in him.

* * *

GERMAN VIEW OF AMERICAN INDUSTRIES.

In one of his characteristic consular reports, Mr. Frank H. Mason, formerly of Berlin, Germany, and now of Paris, France, gives an interesting view of German industrial conditions as regards American competition. Many Germans were visitors to our Louisiana Purchase Exposition, and while in this country took the opportunity of visiting many of our leading shops, and gathering new ideas and impressions of our industrial organization. They have gone home again with much to praise and some things to censure. While admitting freely the boundless resources of our country, the energy, industry, and unsurpassed mechanical skill of the people, the superiority of our factory system, the speed and cheapness of rail transportation, and the restless, progressive spirit which is always looking for a new or better machine and method than the one already in use, the German experts find, or think they have found, defects in many parts of the American system, which, unless reformed, will continue to weaken our grasp upon international trade.

They severely criticise the careless confidence with which agents and salesmen are sent abroad with no special preparation, and with no knowledge of any language except their own. They are amazed at the meagerness of technical education, the trifling annual contingent of chemists, engineers, electricians, dyers, weavers, etc., as compared with the throng of lawyers, physicians, dentists, and unspecialized graduates turned out by our colleges and universities; also the number of graduates from our so-called "commercial colleges," where young men with common school education receive a three months' course in bookkeeping and commercial usages, and believe they have a finished education. In this lack of thoroughness in preparation, they see the weakening of our hold on industrial progress. They believe that the tide of improvement in manufacturing in Europe will swamp America, if she does not grasp the situation and reform.

It has come to be pretty generally believed in this country that the foreigner, especially the German workman, is slow to grasp mechanical improvements and is necessarily a plodder. That this may be a serious mistake on our part is illustrated by an incident which occurred in a large machine shop in Berlin. The manager, preliminary to ordering a new American machine tool, sent to the factory in the United States sample pieces to be worked on the machine in order to ascertain precisely the time that would be saved, and how well the work would be performed. Among the pieces forming the test was one which had been roughed out to the required shape in seven minutes, and it was tagged to that effect. The lathe was ordered, and the American manufacturer soon after visited the German shop and was shown the piece marked seven minutes, with some deprecatory remarks, the Germans believing that such quick time was impossible and that it would take nearer an hour. The American offered to demonstrate it on the lathe which had just been made ready for work, but the German foreman objected, saying that it was unnecessary, for if the American could do it in seven minutes, he could do it as quickly. Two days later he reported that under his supervision, the lathe had done the work in five minutes.

The above would indicate to the thoughtful mind that men of average ability and intelligence are pretty equally matched when a proper incentive is given them to do their best. While the average German workman may be constitutionally slower than our American workmen, the probabilities are that he will be a good second with improved shop conditions, and this with the cheaper mode of life prevalent abroad, will soon make him a most formidable competitor in the machine tool and allied trades which have been regarded as safely within the sphere of American influence.

* * *

The manufacturers of a portable boring bar for steam engine cylinders show photographs of their apparatus in use, boring the valve chambers and cylinder of a Corliss engine. In the view showing the port boring operation, the cylinder head is on and evidently the piston is in place; in the view showing the cylinder boring operation the valves are in place and the valve chambers closed. A correspondent has criticised these operations, claiming that it is very bad practice to bore the cylinder of a Corliss engine without taking out the exhaust valves, or to bore the valve chambers without taking out the piston. While in general we must agree with our correspondent, it can be done with safety in the way illustrated if reasonable precautions are taken. In railway practice valve seats are frequently faced without removing the pistons, the ports being carefully fitted with strips of wood which prevent all chips and dirt falling into the ports; and the same can be done in the port or cylinder boring operations on a Corliss engine. The time saved in dismantling and assembling an engine where only one part is to be repaired is well worth consideration, both in the cost of the labor and in the time saved, but the practice criticised is one that cannot be safely followed unless great care is taken.

ENGINEERING REVIEW.

CURRENT EVENTS, TECHNICAL AND MECHANICAL—LEADING ARTICLES OF THE MONTH.

Mechanical appliances are coming more and more in evidence in the business office as their labor-saving qualities are recognized. A calculating machine is one of these time-saving devices which not only saves time but which insures accuracy of results. The latest development in this line is the addition of an adding attachment to an ordinary typewriter, which not only totals a column of figures but acts as a check upon the accuracy of same. When the typewritist has written the various items of a bill, the sum total is indicated on the adding wheels and is typewritten the instant the items are completed.

The almost universal practice of applying belts to machines requires that as the belt grows slack a piece shall be cut out, to take up the slack. This practice not only wastes the belt, but requires that the end cut off shall be carefully squared up and new belt holes punched in it. The Morse Chain Co., Trumansburg, N. Y., we understand, follow a different practice. They deliberately cut their belts too short, when they are first applied to the machines, by a length of a foot or 15 inches. This must, of course, be filled in by an extra piece. When the belt grows slack this piece is removed and a shorter piece inserted instead. A variety of widths and lengths is kept in the toolroom for this purpose, and when a machine operator wishes to shorten his belt, he determines about how much slack needs taking up, and calls at the toolroom for a piece that much shorter than the one already in the belt. The old piece is returned to be used again as occasion requires.

It is with reluctance that telephone and telegraph companies put their wires underground in cities, but this does not arise altogether because of the cost. Although the cost is heavy, the freedom from interruption of the service because of storms, fires, and other accidents to which overhead wires are subject, largely compensates for it. The chief difficulty lies in the extraordinary increase in the induction of an underground cable as compared with a line wire. It is stated that one mile of underground wire has as great an effect in cutting down the effective transmission as 20 to 25 miles of overhead wire, and that 15 miles of underground circuits in New York City cuts down the current as much as over 800 miles of overhead circuits. In other words it requires as much energy to transmit the current through 15 miles of underground circuit in New York City as from New York to Chicago by the overhead wires.

We are indebted to *Popular Mechanics* for the description of a portable home-made planer, built by an electric railway company in California which had occasion to plane several hundred wooden trolley poles, and found it difficult and expensive to haul the poles to a mill. This consisted of a planer head mounted on a substantial wooden truck and belt-driven by a 5-horse power 500-volt direct-current General Electric motor. The rollers were made of two sections of 10-inch wrought-iron pipe, castings being fitted in the ends for the axle bearings. A pair of plow handles were used to push and guide the planer, the starting box for the motor being mounted between the handles. The entire outfit cost but $60 outside of the motor, which the company had in stock. The poles were 35 feet in length, with 8-inch tops, and it took about one minute to plane down one of the four sides of a pole. The poles were planed as they were unloaded from the cars, at the rate of six poles an hour. There was not only considerable saving in time, but also a great saving in expense, as it cost but ten cents per pole as against $1.15, the price estimated for doing it by hand.

According to the *Electrical Review*, of London, the Great Northern Railway of England has been experimenting with gasoline motive power for suburban traffic. The motive power is generated by two Daimler gas engines of 36 H. P. each. These engines drive onto a common longitudinal shaft which is connected to the two axles of the car by beveled gearing. To overcome the difficulty of one axle overrunning the other, owing to any possible inequality in the diameter of the wheels or for other reasons, a special form of differential gear is introduced, combined with which is the reversing mechanism. The engines are connected through independent clutches to a common change speed box, from which the power is transmitted through the longitudinal shaft to gear boxes suspended on each axle, from which point the speed is reduced by means of single reduction gearing.

A separate gasoline tank is provided for each engine, and the combined capacity of these is sufficient for 400 car-miles. The car is lighted by electricity obtained from storage batteries, which also supply energy for ignition and for the magnetic clutches. The weight of the car, including passengers, is 16 tons, and it is designed for a speed of 30 miles per hour, although it has on several occasions surpassed a speed of 50 miles.

Although artificial gas has a heating value of only from 650 to 700 British thermal units per cubic foot, and a thousand cubic feet, costing in many American cities about $1, contains approximately one-thirty-sixth the heating value of a ton of anthracite coal, hence costs six times as much as coal at $6 a ton, yet, on account of its advantages of convenience, cleanliness and adaptability, gas has obtained a strong foothold as a means of heating buildings. It is particularly valuable for intermittent heating of such buildings as churches, lodge rooms, and other meeting places where heating is required for short periods only during each week. With coal heating a large portion of the heat is wasted, inasmuch as a heavy fire has to be started which perhaps lasts some hours after the need for it is over. With gas heating the fire is easily started, and while it must be started some time previous to the time the heat is required, of course, it can be discontinued immediately after such need is over; but from the point of economy gas heating should be done by gas radiators located in the room. These should be provided with suitable ventilating devices so as not to vitiate the air with the products of combustion.

Smith & Coventry, Manchester, England, it is claimed, have applied a cushion planer drive to their line of planers with very satisfactory results. The drive from the pulley shaft is transmitted through single reduction spur gearing to a large spur gear outside the bed, which is mounted on a shaft carrying a pinion, which engages with the usual bull-wheel meshing with the rack on the under side of the platen. The large spur gear outside the bed is mounted loosely on its shaft, but engaging with it is a clutch whose cam-shaped contour teeth engage with a similar shaped contour on the hub of the gear. The clutch is held against the hub of the gear by a powerful coil spring, the whole forming a combination similar to the well-known Beaman & Smith tapping attachment. When the platen is reversed at the end of the stroke, the spring is compressed for an instant while the inertia is being overcome. It then extends again, giving up the energy stored in it, but does not quite close, the amount of opening corresponding to the work of moving the platen. It is claimed that this cushion drive works well and greatly reduces the shock of reversal on high speeds. It does not appear, however, that it overcomes the greatest difficulty in planer operation, and that is the momentum of high-speed reversing pulleys. The momentum of these pulleys on many designs of planers is far greater than the momentum of the platen and its load. The Smith & Coventry device merely takes care of the inertia of the platen, but contributes little or nothing to overcoming the momentum of the reversing pulleys.

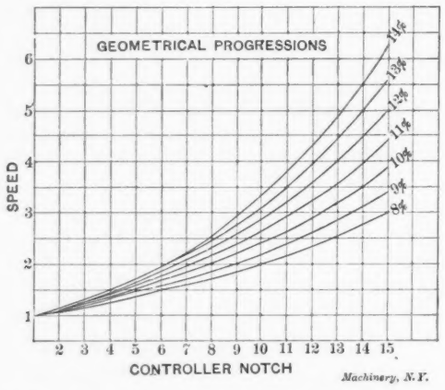
The subject of conductors for protecting buildings from lightning is one upon which there is much misinformation, and it appears exceedingly difficult to discover just what posi-

tion the lightning conductor occupies as a protector of property. Lightning rod agents have played upon the credulity of the public to such an extent that many scientific men have declared that lightning rods are of little or no use whatever. On the other hand it is conceded by others equally well-informed that when properly put up, the lightning rod is a valuable protector of buildings and tall structures, especially brick chimneys. According to Sir Oliver Lodge, who recently delivered an interesting lecture on the subject in Birmingham, an error that is frequently made in the installation of lightning rods is in using rods of too large cross section and of too high conductivity. He says that a copper rod is not as good as an iron rod, for the reason that a heavy copper rod lets down a current too quickly and produces a shock or collision because of the electric inertia or inductive effect; where a copper rod, say, a foot thick would be highly dangerous as a lightning conductor, an iron wire one-tenth inch diameter might be quite safe and effective. A heavy copper conductor is liable to side flashes, but a light iron wire allows the flash to leak down, as it were, and perhaps fuse it with little perceptible disturbance. A number of conductors are better than one, and are better when made of light iron wire than of heavy copper rod. Small iron wire may be fused and destroyed, it is true, but this contingency must be met by renewal. In fact the practice advocated would be very similar to the renewal of electric fuses, and the iron conductor and the fuse might be said to occupy analogous positions. When the fuse blows we expect to renew it, and the same holds true with the small iron lightning conductor.

APPLICATION OF MOTORS TO MACHINE TOOLS.

J. M. Barr. in the Electric Club Journal, January, 1905.

Machine tools are operated under such varying conditions that no general statement can be made covering all of them. Some of the governing conditions which should be taken into account in fitting a motor to a tool are the character of the work, the kind of material cut, the shape, quality, and method of treatment in making the cutting tool, the stiffness of the machine, etc. Whatever the class of machine tool, the variable speed motor generally offers decided advantages for driving, especially with the use of the new high-speed steels. The latter, when working at economical rates, require such pulling power in belts and increased strength in gears, that reasonably fine increments in speed are almost impossible by mechanical methods alone, owing either to the



increased length of the cone pulley or the great size of the change gears. These fine gradations of speed are necessary if the tools are to be worked up to their limit of capacity.

With the variable speed motor, approved practice is to make the ratio between the various cutting speeds increase in geometrical progression. To aid in calculating the speeds for the various controller notches the curves given herewith have been prepared. In this figure the horizontal represents the controller notches and the vertical the multiples of speed for the various notches, with given increments of speed for each notch. For instance, on the fourteenth notch of the controller having 14 per cent increments, the speed would be 5½ times the initial speed. These curves are based on standard practice, in which eight notches are used on the single voltage and fifteen on the double. The controller should be as handy for the operator as possible. In the case of a lathe, good practice places the handle on the tool carriage.

The following formulas for horse power will be useful, especially for estimating, for tools operating under the given conditions. These are for a cutting speed of about 20 feet per minute, water-hardened steel cutting tools, and normal machine tools, as distinguished from the modern high-speed tools. For cutting speeds greater than 20 feet per minute, the horse power required should be increased approximately in proportion to the increase in speed.

For tools having rotary motion, motors should be shunt wound, variable speed.

1. *Lathes*—Engine lathes using one cutting tool:

$$\text{H. P.} = .15\,S - 1 \text{ H. P.}$$

Heavy engine lathes:

$$\text{H. P.} = .234\,S - 2 \text{ H. P.}$$

In which S = swing of lathe in inches.

2. *Boring Mills.*—Particularly for mills having a 30-inch swing and above:

$$\text{H. P.} = .25\,S - 4 \text{ H. P.}$$

Where S = swing of mill in inches.

For smaller mills the formula for heavy engine lathes is approximately correct.

3. *Milling Machines.*—Where W = distance between housings in inches:

$$\text{H. P.} = .3\,W$$

4. *Drill Presses.*—For normal drill presses using water-hardened steel drills, running at a peripheral cutting speed of approximately 20 feet per minute:

$$\text{H. P.} = .06\,S$$

For heavy radial drill presses:

$$\text{H. P.} = 0.1\,S$$

Where S = capacity of drill in inches.

For tools having reciprocating motion, a variable-speed motor with compound winding should be used, as the latter winding assists in holding down the inrush of current at the moment of reversal, when the torque required rises considerably above the normal.

1. *Slotters.*—Normal crank slotters, using water-hardened steels at cutting speeds of from 15 to 20 feet per minute:

Stroke.	Horsepower.	Stroke.	Horsepower.
10 inches.	5	30 inches.	10
18 "	7		

2. *Shapers.*—Shapers using water-hardened tool steels at cutting speed of from 15 to 20 feet per minute:

Stroke.	Horsepower.	Stroke.	Horsepower.
16 inches.	3	24 inches.	5
18 "	3½	30 "	6½

3. *Planers.*—For normal planers using water-hardened steel at cutting speeds of from 15 to 20 feet per minute:

$$\text{H. P.} = 3\,W$$

For heavy forge planers:

$$\text{H. P.} = 4.92\,W$$

Where W = width between housings in feet.

The above formulas are for planers having a ratio of cutting to return speeds of approximately 1 to 3, and cover planers with two tools in operation. If more than two tools are used, or if the ratio between the forward and return speeds is more than 1 to 3, the horse power given by above formulas should be increased.

Attention is especially called, in the use of these formulas, to the low cutting speeds to which they directly apply.

LATHE FOR TURNING ELLIPSES.

Der Pratische Maschinen Konstrukteur, July 21, 1904, p. 117.

An ingenious lathe for turning elliptical sections has recently been brought out by Ch. Montreuil, the principle of whose action is as follows:

In Fig. 1, let O be a center about which a circle is described with OA as a radius. Let this be equal to R. With A as a center and $AB = r$ as a radius describe a second circle. If now A be rotated about O, and B be rotated about A with twice the angular velocity that A has about O, then B will describe

an ellipse with a major axis equal to $R + r$ and a minor axis equal to $R - r$. Suppose the line OA turns through the angle a to OA_1, Fig. 2, and at the same time, the outer portion AB has turned in the opposite direction through an angle equal to $2a$. The point B then lies at B_1, which is well known to be a point on an ellipse. The normal to this ellipse at the point B_1 passes through the point O_1 on the line OA_1 at a point that makes $OA_1 = A_1O_1$. If an ellipse were to be generated by the point B_1 while revolving about its center O, and B should be in constant motion with the ellipse while A is fixed, then B would make two revolutions about A in the direction of the ellipse. At the same time O_1 would be a fixed point through which all normals whatsoever of the revolving ellipse would pass. A tool set in the line of the normal $O_1 B_1$, with its cutting point at B_1, would cut a true ellipse from a piece of work revolving about O. The relative positions of the points O_1, A_1, O and A_1 B_1 must, therefore, be such that $OA_1 = A_1 O_1 = R$, and $A_1 B_1 = r$, and the semi axes of the ellipse cut by the tool be:

$$a = R + r \text{ and } b = R - r$$

In the application of this principle to the construction of an ellipse lathe, M. Montreuil has taken an ordinary lathe and limited the changes that need be made almost exclusively to the carriage so that the machine can also be used for ordinary turning. In Figs. 3 and 4 the arrangement and movements are shown diagrammatically. The line CD, Fig. 4, represents the tool and corresponds to the normal $B_1 O_1$ of Figs. 1 and 2. It passes through the fixed point P. The point C describes a circle x having a radius $\frac{a - b}{2}$ about S as a center. OS_1 is equal to $R = \frac{a + b}{2}$; $A_1 B_1$ is equal and parallel to $C_1 D_1$ and passes through the fixed point O; $D_1 B_1$ is parallel to PO. While the point C describes its circle about S with the radius $\frac{a - b}{2}$, the point A moves through the circle x_1 of the same diameter, so that $B_1 D_1$ is always parallel to PO.

Figs. 5, 6, 7 and 8 give front and end elevations and a plan of the lathe to which this principle is applied. The piece to be turned is held between the centers of the lathe, and the tool k_1 cuts it in a direction normal to the curve of the ellipse, having itself a circular motion. For this purpose the toolpost k is moved in and out in the carriage slide, which, in its turn, can swing through the arc of a circle. The toolpost k corresponds to the line AB of Fig. 4, which passes through the center of the semicircular opening to the fixed point O. In the following explanation of the principle of operation of this machine, the letters enclosed in brackets refer to Fig. 4:

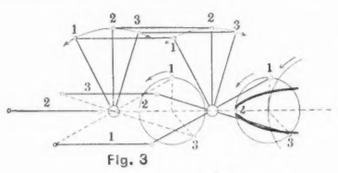


Fig. 3

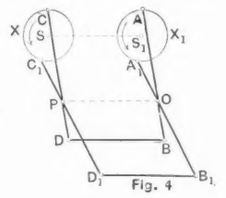


Fig. 4

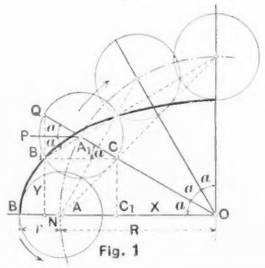


Fig. 1

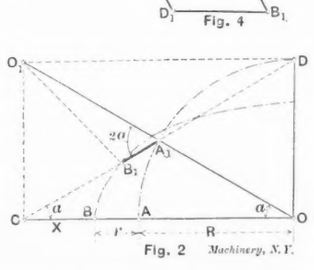


Fig. 2 Machinery, N.Y.

The rotary carrier of the toolpost k, Fig. 9 is so arranged that the point of the tool itself describes the circle k_2, whose diameter is $a - b$, twice, while the piece being turned makes one revolution. These revolutions are both in the direction indicated by the arrows. The carriage e is driven by the pin f of the disc g, whose revolutions are controlled by the long splined shaft m, Figs. 5 and 6, which in turn is driven in the same direction as the spindle but with twice its angular velocity by means of the intermediate gears m_4, and this motion is transmitted to the disc g through the gears n_1, n_2 and n_3. This, then, moves in the same direction but with twice the speed of the working ellipsoid, so that the point of the tool makes two revolutions while the piece being operated upon makes but one. The shaft of the intermediate gear n_2 is carried by two swinging arms, p, p_1, by means of which it can be thrown out of gear if a circular piece is to be turned. The pin f (C) of the disc g can be moved to or from the center (S) by means of a screw whereby the circle described by it or the tool point may be adjusted so that its radius $r = \frac{a - b}{2}$. By varying this radius an ellipse with any ratio between the major or minor axes can be turned. From this it will be seen that the actual circular motion of the tool is obtained as the resultant of an oscillating motion in the arc of a circle and the vibratory motion of the toolpost. The feed of the cutter is obtained from the leadscrew, Figs. 5 and 6, driving a nut attached to the carriage in the usual way.

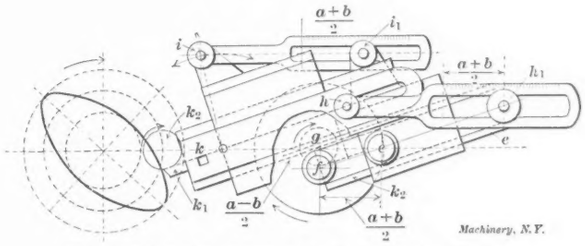


Fig. 9. Detail of Movement of Lathe for Turning Ellipses.

PRODUCER GAS ENGINES ON SHIPBOARD.

Marine Engineering, January, 1905.

Bernard A. Sinn, writing in the above magazine, tells us that the gas engine, and probably eventually the gas turbine, will be the solution of the propelling question for marine purposes. This engine or turbine will, apparently, be supplied from a gas producer plant installed on shipboard, since the high price of liquid fuel has so far prevented the adoption of gas engines of large powers for ship propulsion. Some success has been met with in the equipment of vessels with oil engines, but serious objections are presented to this type in the higher insurance rate demanded, owing to the popular belief that oil fuel is difficult to handle, and in the non-reversibility of the engine. In order to drive astern a vessel so equipped the use of heavy reverse gears is customary. Gears to reverse an engine of 5,000 I.H.P. having an 18-inch crankshaft, would needs be 12 feet in diameter and of 4 feet face.

Manufacturers of marine gas engines in the last two years are, however, building engines that may be reversed by compressed air. This is accomplished by cutting off the gas, turning the cam shaft 90 degrees, and sending compressed air into the cylinder, when the change in the time of admission and exhaust is sufficient to catch tthe engine in the reverse motion in one of the three cylinders and reverse the same. As soon as the engine is started in the opposite direction gas is admitted through the proper valves, the time of ignition arranged to suit, and the engine operated in the reverse direction in the same manner as previously in the go-ahead motion. All this is accomplished with one lever and valve, the lever operating the cam and ignition shafts, and both of the compressed air and gas valves.

A gas propelled vessel needs, in addition to the main driving engines, exhausters for the gas producers; an air compressing plant to reverse the main engines, operate other gear, and blow the whistle, circulating pumps for circulating water through the main engines, and to give water to the steamer of the producers, and other auxiliaries not directly used for the main engines. An electric plant should be installed on board, direct-driven from the engines. This will furnish power for running the auxiliaries more cheaply than would be possible by the direct use of the steam. Electrically driven pumps are now made of a higher efficiency, and much more economical, than direct-driven steam pumps. The compressed air would

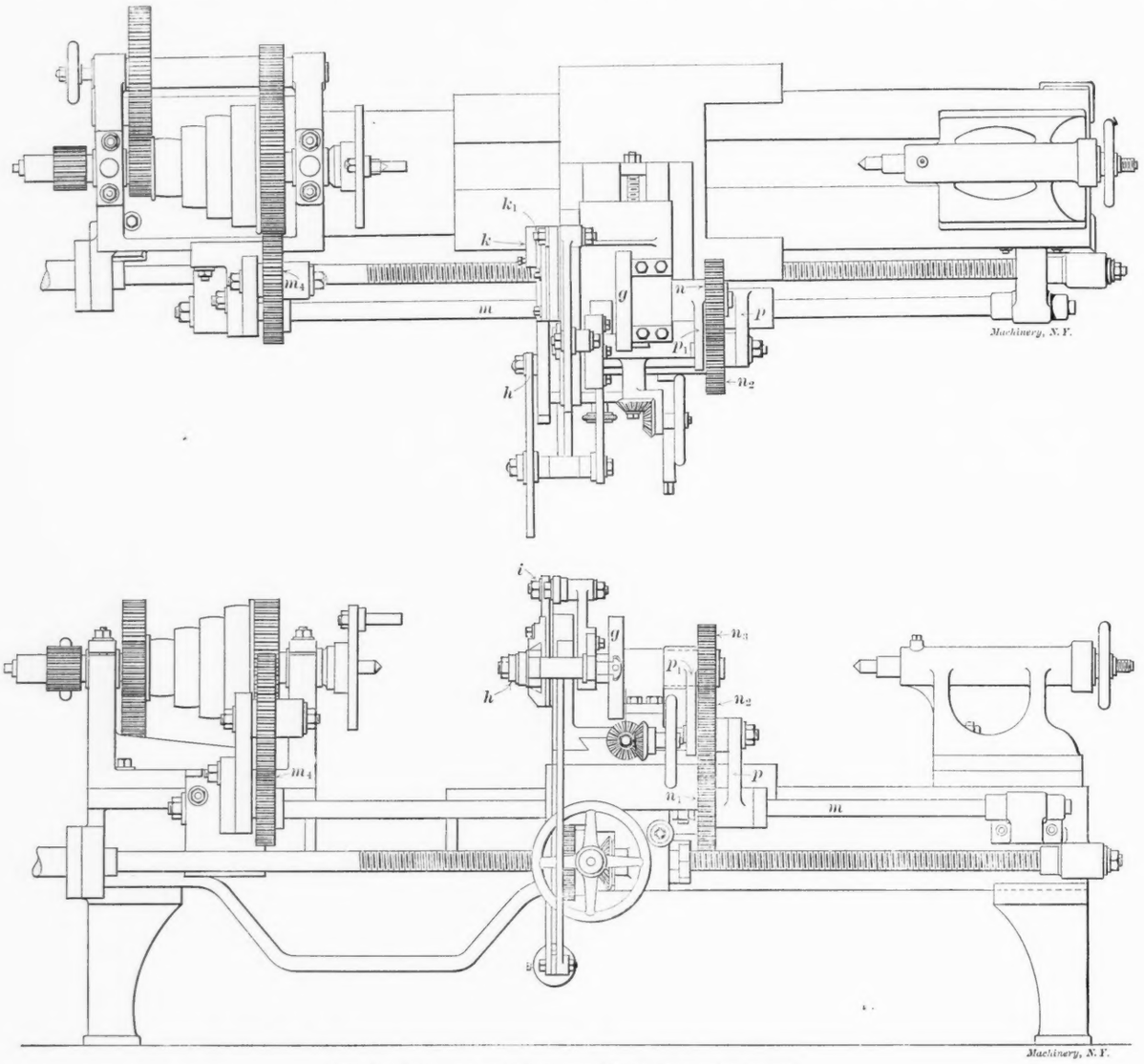
be furnished by a small, electrically-driven air compressor for the start, and, if desired, from the main engines when running. These machines are now built so that the power is regulated by the pressure, so that practically a constant air supply is furnished.

In considering large powered gas engines for marine purposes, it is necessary to turn to land practice for the necessary information. Vertical gas engines of 3,000 to 5,000 H.P. have been successfully installed, both in this country and abroad, for the production of electric and other power. The four-cycle engine, as built to-day in large powers, can be safely recommended as the best adapted type for marine purposes. A three-cylinder, double-acting, four-cycle engine giving six explosions in each two revolutions, the same as a two-cycle single-acting engine, would be suitable.

Cam shafts and ignition shafts are operated by gearing from the main shaft. For each valve there should be three cams, one for forward motion of the engine, one for going astern, and one for operating the valve when the engine is being reversed. For this purpose the cams are movable on their shaft, and moving and locking devices are provided.

The piston is convex on top and bottom, and is ground into the cylinder. Stuffing boxes are very deep, with heavy packings. Cylinders, ports, valves, chests, exhaust valves, pistons, tail rods and connecting rods are water-cooled. The material for an engine of this type must be the strongest.

The gases, after being burned in the cylinder, are led to a muffler, where the sound of explosion is reduced, and the heat in the exhaust gases utilized for heating water for heating purposes. The air compressing plant consists of two



Figs. 5 and 6. Plan and Elevation of Lathe for Turning Ellipses.

In considering the proportions of the engine, 85 cubic feet of producer gas should be sufficient, with high compression, for 1 I.H.P. Piston speeds have not yet risen above 800 feet per minute. A mean effective pressure per explosion of 70 pounds should be obtained. From these considerations the size of the cylinders is determined. The speeds of the inlet and exhaust gases should be 100 and 85 feet per second, respectively, and valves and ports should be designed accordingly. Valves should have an area of 15 to 20 per cent of the cylinder area, and should have very quick action. The mixture should be of about equal parts of producer gas and air. The compression space for a compression of 150 pounds per square inch should be one-quarter the volume of the piston displacement.

independent units storing air in tanks at high pressure, whence it is piped to the reversing valve and whistle.

The electric plant is the most important of the auxiliaries. As soon as the starting producer is supplying gas the electric plant is ready for operation. It must store up energy in the accumulators; be ready to operate such pumps as require to be used; drive the blowers for starting the main generators, and also the exhausters for supplying gas to the main engines; it must run the various small pumps throughout the vessel, the deck machinery, steering gear and windlass, and supply light as needed, and supply the ignition spark for the engines. The dynamos are connected to the gas engines and the piping is so arranged that the gas engines may take gas either from the starting machines or from the main producers.

As the storage batteries also are connected to the main switchboard the motors may be operated from generators or from storage batteries.

The two main driving engines, with their thrust bearings, as is customary in twin-screw vessels, occupy the center of the engine room space. On each side on the floor are air compressors and tanks and such pumps as are necessary. On platforms built at the forward end of the engine room are the exhausters which suck the gas from the gas generators and deliver it to the engine. On a platform at the after end of the engine room are the dynamos. Above the hold stringer on each side are the mufflers and hot water heaters, and in the lower 'tween decks the refrigerating plant, machine shop and other small auxiliaries. The storage batteries are placed well out at the side between the frames and on the stringers. The blowers for starting the generators are also situated in the engine room.

WEIGHTS FOR 10,000 I. H. P. MARINE ENGINES.

Steam Power Vessels.	Tons.	Gas Power Vessels.	Tons.
Main engines	385	Main engines	465
Condensers	56	Heaters and mufflers	32
Boilers	315	Generators	165
Uptakes, stacks, etc	86	Relief and exhaust pipes	38
Fans, feed heaters, etc	41	Exhausters and blowers	36
Pumps and auxiliaries	19	Compressor air plant, pumps, etc	66
Electric light plant	20	Electric plant	40
Spares and sundries	15	Spares and sundries	18
Donkey boiler, complete	32	Starting machines	22
Water in boilers	180	Water in generators, etc	45
Total	1,149	Total	927
Coal	1,950	Coal	1,000
Grand total	3,095	Grand total	1,927
First cost	$295,300.00	First cost	$246,200 00
Cost per I. H. P.	29 53	Cost per I. H. P.	24 62

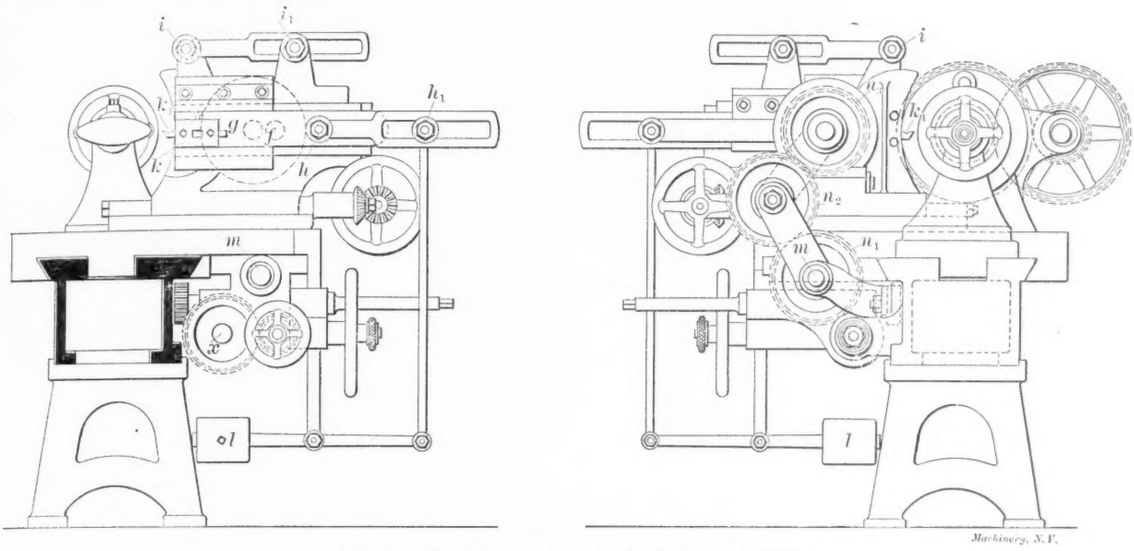
	Steam Power Vessel.	Gas Power Vessel.
Interest, depreciation, and insurance	$27,620	$21,480
Coal, annually (150 days' steaming)	90,000	48,500
Service (engine and fire room crews)	30,000	12,000
Oils and stores	3,650	5,600
Repairs and sundries	15,000	12,000
	$166,270	$99,580
Annual saving	$66,690	
Added cargo capacity 1,150 tons. Value of added cargo carried	46,000	
Total saving	$112,690	

being about 10 per cent. on the whole cost of the vessel.

In the above tabulated statement a comparison of costs and weights for a 10,000-I.H.P. plant is made by the author, and a decided saving in first cost, in operating expenses, in space, in weight, and an increase in carrying capacity and a large increase in earning capacity are shown, so that the future of gas-propelled vessels would seem to be assured as soon as engine builders supply proper machines.

A COMMERCIAL UNIPOLAR DYNAMO.

A paper presented by Mr. J. E. Noeggerath at the January meeting of the American Institute of Electrical Engineers, on the subject of "Acyclic (Homopolar) Dynamos," described a dynamo of the type usually known as unipolar, recently designed and built in the shops of the General Electric Company. As this is a type on which investigators have worked for years without producing anything of practical value, the apparent success of the 300-kilowatt, 500-volt, turbine-driven acyclic generator described by Mr. Noeggerath has excited a great deal of interesting discussion.



Figs. 7 and 8. End Elevation of Lathe for Turning Ellipses.

The earliest type of generator, the Faraday disk, was a homopolar machine which developed only a fraction of a volt e. m. f. Since that time, many designers have attempted to build commercial machines of this type, without success, on account of insufficient speed and mechanical and magnetic difficulties. Mr. Noeggerath has been aided in his machines by the advent of the high-speed dynamo.

Acyclic (non-cyclic) generators are classified according to the position of the armature conductors, as the radial type, having one or two disks, and the axial type, having one or two cylinders, either solid or hollow. The generator here considered is of the cylinder type. It consists chiefly of a solid armature of mild cast steel, and a cast steel frame. On the smooth armature surface are longitudinally disposed 24 straight conductors, insulated flat copper strips. These are connected at both ends to insulated steel collector rings, one of each pair of rings being on each side of the armature core. There are twenty-four of these rings, twelve on each side of the armature. The successive armature conductors are connected in series through fixed copper brushes resting on the rings and fixed connecting wires carried through the mass of the stator, or frame. The twelve collector rings on either side of the armature, of equal diameter with it, are assembled close together and mounted on a shell. The field is a cast steel structure extending toward the shaft in three polar projections that enclose the armature in complete cylinders. Two field coils are wound concentrically with the shaft. Eight openings in the frame give access to three brushes each, making a total of twenty-four contacts. The stationary circuit consists of twelve cables.

The machine here described was run at high speed by a steam turbine, developing 300 kilowatts, 500 volts, and an efficiency of 91 per cent. Various precautions are taken to neutralize the ring and armature reactions which tend to cause variations of the magnetic field. The brush friction has been a cause of much trouble in previous homopolar generators, but in this case does not seem to be so serious as feared, amounting to only about 500 watts.

The acyclic dynamo offers some considerable advantages for direct-current machines. It is a simpler type than any in use, returning to the smooth core armature, and eliminating the commutator and the attendant troubles. Another advantage is the perfectly uniform voltage given. There is no necessity for

laminating any of the parts, for because of its magnetic distribution there is but little hysteresis loss and but little tendency for eddy currents to be set up. As uniform a distribution of flux through the air gap is produced as possible. The machine is said to compound itself by simply shifting the collecting brushes. The regulation should be good. The air gap is reduced to a mere clearance, thus reducing the magnetizing force necessary. The generator should be a cheap construction, viewed all around, and as the mechanical difficulties of brush-friction while collecting current at the high speed used, etc., seem to be solved to quite an extent, a considerable step in advance has apparently been taken.

GAS ENGINE TESTING.

The Engineer, January 1, 1905.

In gas engine tests the observations to be taken should consist of the temperatures and pressures of the gas and air supplied; the temperatures of the entering and leaving jacket water and of the exhaust gases, of the volume of gas used, of the quantity of jacket water, of the number of explosions and revolutions per minute, and of the data necessary to determine both indicated and brake horse power of the engine, and of the engine constants. For making the test, thermometer cups should be inserted in the water pipe so that the temperature of the jacket water may be taken just before it enters and after it leaves the jacket. The water used should be piped to a tank resting on a scale, so that its weight may be ascertained at stated intervals. The gas consumed should be measured by a meter which has recently been calibrated, and it should be seen to that all gas consumed passes through this meter. The temperature of the gas should be taken by the thermometer hanging beside the meter, and the pressure above the atmosphere in inches of water by a manometer connected to the gas line.

The power developed in the cylinder is measured by an indicator similar to the steam engine indicator, which should, however, have a piston ¼ square inch in area, so that an excessively heavy spring will not be required on account of the high pressure in the gas engine. The indicator spring should be surrounded by a water jacket. Delivered power should be measured by some form of a Prony friction brake. Suitable forms are the band and lever type and the drum and rope type, but as these are well known they need not be described. The brake horse power may in some cases be measured without the use of a Prony brake, as for instance in the case of an engine direct-connected to a generator.

Before testing the engine, it should be put in good working condition. Valves should be inspected and reseated if necessary, the sparking apparatus should be overhauled, and the cylinder oil should be supplied uniformly to the cylinder. The most important facts concerning the engine which should be recorded are, its type; method of governing; method of ignition; kind of fuel used; stroke of engine; diameter of piston, and volume of clearance. The engine should be started up and run for at least an hour after the preliminary preparations have been made, in order that it may be thoroughly heated up and the conditions may become constant. The jacket water should be regulated so that it leaves at a temperature of about 160 degrees F., which is considered to be the best leaving temperature. The gas and air should be regulated for best proportions of combination, that is 1 to 10 when illuminating gas is the fuel used. It is very important that the scale reading should be kept constant. Average data for a test can usually be obtained from an hour's run, but if an endurance run is desired 7 to 10 hours should be sufficient.

Reading should be taken every ten minutes, and should be recorded as follows: Revolutions per minute; explosions per minute; cards taken from indicator; net force on brake arm; pounds of jacket water; temperature of entering jacket water; temperature of leaving jacket water; cubic feet of gas; pressure of gas in inches of water; temperature of gas at meter; temperature of exhaust gases; cubic feet of air; temperature of air. Barometric pressure and the heating value of fuel should be recorded once an hour. The gas consumed may be found for a short run by the rate method, that is, by recording the time in seconds for the consumption of 10 cubic feet of the gas. For long runs it is better to record the total quantity of gas consumed.

From the recorded data there should be computed: Indicated horse power; brake horse power; heat carried away by jacket water; cubic feet of gas (standard conditions); cubic feet of air (standard conditions); ratio of gas to air; British thermal units per indicated horse power per hour; British thermal units per brake horse power per hour; efficiencies of engine.

The indicated horse power is expressed by the formula:

$$\text{I. H. P.} = \frac{P\,E\,A\,L}{33{,}000}$$

in which P is the mean effective pressure in pounds per square inch, as obtained from the indicator card, E is the number of explosions per minute, A is the area of the piston in square inches, L is the length of the stroke in feet. $\frac{A\,L}{33{,}000}$ is constant for a given engine.

The mean effective pressure is found, as is well known, by dividing the area of the indicator card in square inches as measured by a planimeter, by the length of the card in inches, which product, the mean height of the card, is multiplied by the scale of the indicator spring. If the indicator has a reduced piston, multiply by twice the scale of the spring.

The brake horse power is computed from the formula:

$$\text{B. H. P.} = \frac{2\,\pi\,l\,N\,W}{33{,}000}$$

in which l is the distance in feet from the center of the brake wheel to the knife edge of the Prony brake, or the radius in feet of the brake wheel if a rope brake is used, N is the number of revolutions per minute, W is the net weight in pounds on the scales.

$\frac{2\,\pi\,l}{33{,}000}$ is constant for a given Prony brake.

If l is made 5¼ feet this constant is 0.001, so that,

$$\text{Brake horsepower} = \frac{N\,W}{1{,}000},$$

which is a very convenient formula in which to substitute.

Heat carried away by the jacket water in British thermal units is the product of the number of pounds of water discharged and the difference in temperature of the entering and leaving jacket water. The total British thermal units carried away per hour divided by the brake horse power gives the British thermal units taken away by the jacket water per brake horse power per hour.

Gas consumed must be reduced to standard conditions of pressure and temperature, in order to determine the cost in thermal units of each horse power hour.

The standard conditions usually taken are a pressure of 30 inches of mercury and 62 degrees F., and reductions are made to them by means of the formula,

$$\frac{p_s\,v_s}{T_s} = \frac{p_1\,v_1}{T_1},$$

in which $p_s = 30$ inches of mercury,

p_1 = pressure of gas at meter.
= barometer reading + (0.074 × reading of manometer in inches of water).

$T_s = 461 + 62 = 523$ degrees F.,

T_1 = absolute temperature of gas.
= temperature of gas at meter + 461.

v_1 = volume of gas registered by the meter.

v_s = volume required,

$$\text{Then } v_s = \frac{v_1\,p_1}{T_1} \times \frac{T_s}{p_s} = 17.43\,\frac{p_1\,v_1}{T_1},$$

since T_s and p_s are constants.

During any given test p_1 and T_1 are nearly constant so that

$$v_s = R_s\,v_1$$

$$\text{in which } R_s = 17.43\,\frac{p_1}{T_1}$$

If the barometer is 29.43 inches mercury, manometer 5 inches

water, temperature of gas 72 degrees, $v_1 = 349$ cubic feet, find the volume of gas for standard conditions.

$p_1 = 29.43 + (0.074 \times 5) = 29.8.$

$T_1 = 72 + 461 = 533,$

and

$$R_s = \frac{17.43 \times 29.8}{533} = 0.974.$$

Then, $v_s = 0.974 \times 349 = 340$ cubic feet.

If the air has been metered during the run, it may be reduced to standard conditions by the formula used for the gas.

The total British thermal units per hour is the product of the number of cubic feet of gas used per hour, and its heating value. The total British thermal units per hour divided by the brake horse power gives the British thermal units per brake horse power hour. The total British thermal units per hour divided by the indicated horse power gives the British thermal units per indicated horse power hour. By friction horse power is meant the difference between the indicated horse power and the brake horse power, or it is the indicated horse power when the engine is running under no load.

Efficiencies of the engine are of two kinds, thermal and mechanical. One horse power for an hour equals the performance of 1,980,000 foot-pounds of work, or the equivalent of 2,545 British thermal units. The ratio of 2,545 to the British thermal units per horse power gives the thermal efficiency of the engine.

The mechanical efficiency of the engine is the ratio of the brake horse power to the indicated horse power.

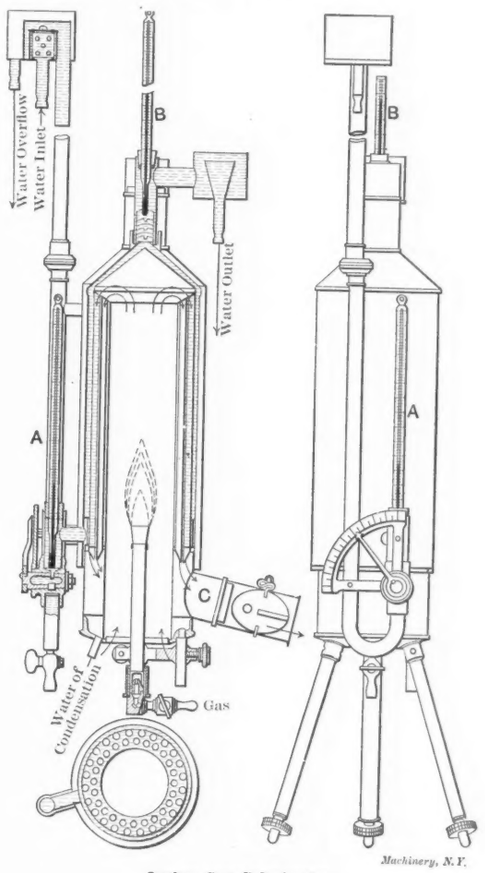
Besides these various quantities, the distribution of the heat supplied should be known in per cent; that is, the proportion of the heat supplied going to useful work, the per cent lost in engine friction, that lost through radiation, and that carried off by the jacket water and the exhaust, should all be calculated.

The determination of the heating value of the fuel is of course important for all these calculations. The best instrument for this determination is the Junker calorimeter. This instrument, which is shown in the accompanying figure, has the advantage of being portable, of burning the fuel at atmospheric pressure, and of being operated continuously for any length of time. It is essentially a device for abstracting the heat from the gas which is burned in the central chamber of the calorimeter, by a supply of water which passes around the outside of this chamber. The weight of this water passing in a given time and its temperature on entering and leaving are measured. The heat given up by the gas thereby becomes known. This calorimeter is used in connection with a test meter, a pressure regulator, a tank resting on a pair of scales for the cooling water, and a water manometer connected to the meter for measuring the pressure of the gas. The course of the gas is through the meter, the pressure regulator and calorimeter. The whole set is preferably enclosed in a glass case, so that currents of air may not affect it.

The section of the calorimeter to the left shows the gas flame in position. The gas enters as shown, and air is admitted through a regulating device just above it. The products of combustion ascend to the roof of the combustion chamber, pass down through the cooling tubes shown in the lower section, which are entirely surrounded by the cooling water, surrender their heat to the cooling water, and finally pass off into the air, as indicated at *C*, at the temperature of the room. The circulating water is supplied at a constant head by means of the overflow device indicated at the left, its temperature being taken by a thermometer, *A*. It next passes up through the water jacket surrounding the copper cooling tubes, in a direction opposite to that of the hot gases within the tubes, and absorbs heat from the gases. It passes out at the top of the calorimeter, where its temperature is noted by thermometer *B*, thence to the weighing tank. Water formed by the combustion of hydro-carbons collects from the exhaust gases at the bottom of the combustion chamber, and is strained off through the outlet shown. The whole cylinder and the top are surrounded by an air jacket to prevent radiation.

In order to determine the heating value of the gas, four quantities are to be ascertained: (1) The number of cubic feet of gas burned; (2) the quantity of cooling water used; (3) the rise in temperature of the cooling water; and (4) the quantity of water condensed from the exhaust gases.

In operating the calorimeter, the cooling water is first allowed to flow through the upper overflow, and then to pass through the calorimeter by opening a regulator near the bottom of the calorimeter. Gas is then turned on at the meter and lighted at the burner. The flow should be such that one cubic foot is burned in from 10 to 15 minutes. The cooling water should be so regulated that its increase of temperature is only 10 to 15 degrees. The thermometers used in the cooling water are graduated to 1/10 degree.



Junker Gas Calorimeter.

Readings may be taken after a short preliminary run when satisfactory regulation has been achieved. The meter and the cooling water measurements should be read simultaneously. The temperatures of the entering and leaving water may be taken alternately every half minute.

The heating value, *H*, of the gas may then be computed from the formula

$$H = \frac{(t_1 - t_2)\ W}{V}$$

in which t_1 and t_2 are the average temperatures of the cooling water, W is the weight in pounds of the cooling water, and V is the number of cubic feet of gas reduced to standard conditions of temperature and pressure.

The value of *H* as just obtained is somewhat too large, since under practical conditions the water formed by the complete combustion of hydro-carbons in the gas engine is not condensed, but passes off into the exhaust, carrying with it its heat of vaporization. To find the "effective" value of *H*, the weight of condensed water in pounds is multiplied by 966, and divided by the number of cubic feet of gas. This result is then subtracted from *H*, giving the effective value of the heating power of the gas in British thermal units.

The following determination of *H* is from a sample test:

Cubic feet of gas, 0.606.

Cubic feet of gas (standard conditions), 0.598.

Number of pounds of cooling water, 15.12.

Temperature of leaving water (average), 69.17 deg. F.

Temperature of entering water (average), 44.47 deg. F.

Temperature of room, 63.14 degrees F.
Number of pounds of condensed water, 0.029.

$$H = \frac{(69.17 - 44.47)\ 15.12}{0.598}$$

$$= 626 \text{ B. T. U.}$$

$$H^1 = 626 - \left(966 \times \frac{0.029}{0.598}\right)$$

$$= 579 \text{ B. T. U.}$$

EPOCHS IN MARINE ENGINEERING.

From paper by Rear-Admiral George W. Melville, U. S. N., before the A. S. M. E. Monthly Meeting, January 31, 1905.

It is interesting to note that the steam log of the *Fulton*, the first American steam man-of-war, for January, 1838, shows that the maximum steam pressure was 11 pounds, the vacuum 24 inches, and the maximum revolutions per minute 18. The *Fulton* was a paddle-wheel steamer. The screw propeller was brought forward for driving large vessels about 1838, although its first successful application was made on a small steamer as early as 1804. It was about 10 years later that the propeller began to come into general use, and entirely displaced the paddle wheel for ocean-going steamers. The reason for this change is largely that on a long ocean voyage the change in displacement is due almost entirely to the consumption of fuel. In the case of the propeller this makes practically no difference in its immersion or its efficiency, while in the case of the paddle wheel the immersion of the floats would be changed, with a diminution of efficiency.

Multiple screws were used as early as our Civil War in some vessels. Twin screws were first used in war vessels where the necessity for keeping the machinery below deck made it more advantageous to apply the power to two shafts. They were much longer in coming into use in the merchant service, but since the era of the swift transatlantic steamers all the very large vessels have been built with twin screws. Triple screws have been used to a considerable extent in the navies of France and Germany, and were included in the design of the fast American cruisers *Columbia* and *Minneapolis*, although this feature has not been repeated in later American design. With the advent of the steam turbine in ships, multiple screws have again come to the front, this time on account of the extremely high speed of rotation of the shafts. Merchant and war vessels, turbine-driven, have been fitted with three and four shafts, with a number of propellers on each.

The introduction of the surface condenser was necessary for the full utilization of the now rising steam pressures, since the jet condenser previously used meant the deposition of a scale on the heating surface of the boilers from the salt water used. With low pressures this did not greatly affect the economy of the boilers, except that on blowing off to keep the density of the water down, a certain loss of heat resulted.

The early boilers in sea-going vessels were of what has been called the box type, that is the boiler was a cubical box with a thin shell, the real strength being given by braces running in three directions. This type was superseded by the cylindrical type which was at first single-ended with two furnaces, but with the introduction of reliable mild steel, sizes were increased and cylindrical boilers to-day have as many as 8 furnaces. Cylindrical boilers continue to be favorites in the merchant marine, with pressures running as high as 220 pounds. The water-tube boiler has, however, made great strides in marine service, and is generally used in the navy.

The object of the water-tube boiler is to reduce weight, give greater safety against explosion, greater rapidity in raising steam, and increase the economy in the generation of steam. In its recent use it dates from about 1880. There are two general classes of water-tube boilers, those with straight tubes of large diameter, say 4 inches, and those with curved tubes of small diameter, from 1 inch to 1½ inches. The large straight tube boilers are not so light as the ones with small tubes, and it is more difficult to secure adequate economy, which is dependent largely upon skillful baffling. They do not permit of such rapid raising of steam as the smaller tube boilers; on the other hand, they permit the replacement of a defective tube and of cleaning the tubes much more readily than the tubes which are bent. As far as safety against explosion is concerned there can be no doubt that there is less danger of an actual disaster affecting the whole ship with the use of water-tube boilers than with the cylindrical type. It has now become the established practice in all navies to use only water-tube boilers in new ships. Our English friends had some trouble with the *Belleville*, but this seems to have been due to some extent to lack of familiarity with it.

The compound engine dates from almost the beginning of steam engineering. Up to the time of the Civil War expansion was practiced to an almost ridiculous extent, although Isherwood's experiments in 1861 demonstrated that with low pressures only a very moderate expansion was permissible. When the pressures had gotten up to about 60 pounds the compound engine began to assert itself. As steam pressures rose, the leaders of the profession became convinced that to secure adequate economy a further stage of expansion was necessary, and this brought about the triple-expansion engine, the credit for which is deservedly given to Dr. A. C. Kirk, of Glasgow. It seemed a logical extension of this idea that with a still further increase of pressure there should be a quadruple-expansion engine, but the advantage as compared with the triple-expansion engine does not seem to be clearly demonstrated.

One can hardly realize to-day what a change came in engineering when the production of mild steel became a commercially reliable matter. The difference between a large wrought iron shaft, such as old Hughey Dougherty used to make at the Morgan Iron Works, and one of the mild steel shafts made at Bethlehem, is as great as could be imagined. I do not possibly see how we could have built engines of the power now common with wrought iron for piston and connecting rods and shafting. The change began in the later seventies, and had become almost complete by the end of the eighties. The use of steel castings in the place of iron castings was made to quite an extent at the same time with a great consequent reduction in weight. The introduction of the new material was of course hampered at first by a lack of knowledge of its particular qualities. About the time that steel began to displace wrought iron, white metal for bearings, and the stronger bronzes also came into use. We may also mention the gradual displacement of copper for piping by steel pipes.

In naval machinery forced draft has been of the greatest possible importance, because it has reduced boiler weights almost one half. It is obvious that if the rate of combustion is increased from 10 pounds of coal per square foot of grate to 40 pounds, there ought to be an attendant increase of heating surface. At about the same time as the reintroduction of forced draft in naval vessels, higher rotational speeds came into use. In the early days 60 or 70 revolutions per minute for an engine of 4,000 or 5,000 horse power was about the limit, but in engines of as much as 8,000 horse power for a single set, one finds the revolutions to-day as high as 130. With increased speed, better material, etc., the production of power for a given weight of machinery has necessarily increased. It is interesting to note that in the *Warrior* of 1861, with 22 pounds of boiler pressure and 54 revolutions, the horse power per ton of machinery was six, while in the *Minneapolis* of 1891, with 165 pounds pressure and 133 revolutions, the horse power per ton is 10.9.

The latest note of progress in marine engineering seems to be the advent of the steam turbine. A number of small vessels of the torpedo boat class have been built with steam turbines, and this has been followed up by their use in a number of excursion steamers, etc., and will shortly be followed by their transatlantic use. The questions of reversal, and economy where both power and speed are reduced, has bothered marine engineers in connection with the installation of steam turbines. In some of the latest practice, the reversing turbines are placed inside the exhaust passages of the ahead turbines so that while the ship is going ahead these turbines revolve idly in an excellent vacuum. When the ship is to be reversed, steam is admitted direct to these turbines and secures the reversal. Regarding economy, it seems hopeless to expect any machinery to work with the same economy at 1-10 power that it does at full power, and it is unreasonable to expect the turbine to do this when the reciprocating engine does not.

LETTERS UPON PRACTICAL SUBJECTS.

SQUARE THREAD TAPS IN SETS.

Editor MACHINERY:

Having seen the letter in the January issue of MACHINERY, "Acme Taps in Sets," with table giving proportions of same, I thought it would be of interest to your readers to also give a table of dimensions for square-thread taps, same being nearly as much used as the Acme form, and still more particular to make. To give the advantage of uniformity for comparison between the former table and this, I have condensed my data, and put in a table of the same general appearance as in the letter referred to.

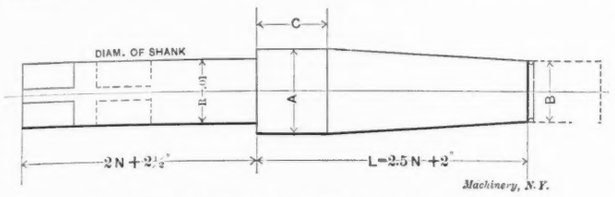


Diagram of Elements of Square Thread Taps in Sets.

ELEMENTS OF SQUARE THREAD TAPS IN SETS.

N = nominal size of tap.
R = root diameter.
T = N − R = 2 (height of thread).
Taper in bottom of thread for about 1 inch from small end in first tap only. Finishing tap should be center-relieved on top of thread.
If first tap is made with pilot, as dotted line shows, add pilot to length of thread, but length over all remains the same.
Length of pilot = .75 × nominal diameter of tap.

No. of Taps in Set.	Tap.	*A*	*B*	*C* expressed in fractions of *L*
2	1st	$R + .67\ T$	R	$\frac{1}{8}$ to $\frac{1}{6}$
	2d	N	A on 1st tap − .005	$\frac{1}{4}$ to $\frac{3}{16}$
3	1st	$R + .41\ T$	R	$\frac{1}{8}$ to $\frac{1}{6}$
	2d	$R + .80\ T$	A on 1st tap − .005	$\frac{1}{6}$ to $\frac{1}{5}$
	3d	N	A on 2d tap − .005	$\frac{1}{4}$ to $\frac{5}{16}$
4	1st	$R + .32\ T$	R	$\frac{1}{8}$
	2d	$R + .62\ T$	A on 1st tap − .005	$\frac{1}{6}$
	3d	$R + .90\ T$	A on 2d tap − .005	$\frac{1}{5}$
	4th	N	A on 3d tap − .005	$\frac{1}{4}$ to $\frac{3}{16}$
5	1st	$R + .26\ T$	R	$\frac{1}{8}$
	2d	$R + .50\ T$	A on 1st tap − .005	$\frac{1}{8}$ to $\frac{1}{6}$
	3d	$R + .72\ T$	A on 2d tap − .005	$\frac{1}{6}$
	4th	$R + .92\ T$	A on 3d tap − .005	$\frac{1}{5}$
	5th	N	A on 4th tap − .005	$\frac{1}{4}$ to $\frac{3}{16}$

It will be noted that my dimensions, gathered from various sources, conform fairly closely to those given for Acme taps, a result to be expected in so far as both tables are based upon practical experience. There is, however, a decided difference in some respects between square and Acme thread taps, and it will be seen that the work for each tap in a set of square taps is about the same for all of them, the finishing tap excepted. The reason for this is very obvious inasmuch as in a set of square-thread taps each tap is a finishing tap in itself, because the lands of each tap are alike. In a set of Acme taps each tap may be considered as a finishing tap for the preceding one. The last tap in each set has less work to do in order to assure a smooth bottom of the thread in the nut tapped.

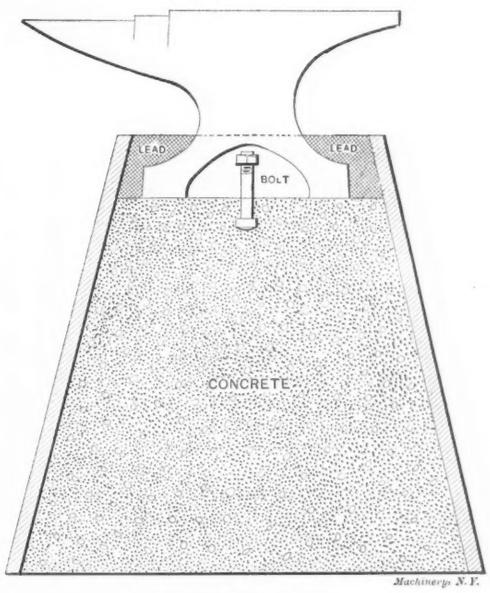
As will be seen from the sketch the first tap is made with a pilot, which is quite important, as it insures a straight-tapped hole in the nut, a result which otherwise is not easily obtained. Dimensions of length in my table are only given as guides, as special conditions will require somewhat different lengths of threaded part and shank. H. D.

IMPROVED ANVIL BLOCK.

Editor MACHINERY:

There is nothing which makes a forge room so untidy in its appearance as anvils carelessly placed on wooden blocks. Even those secured firmly to the blocks by means of straps of iron, bolts or staples, in time work loose, shift about and frequently fall off altogether. The anvils and blocks have been a source of annoyance, and an eyesore in the College of the City of New York. To hold the anvil firmly, to have it look neat, and at the same time to make it as noiseless as possible when in use, has been a problem demanding much thought and experience.

As it is desired to use wrought-iron anvils in preference to cast iron, several experiments have been made. The result is that two blocks are now in use in the forge room; one is mounted with a Trenton and one with a Hey & Badden anvil, both being wrought-iron anvils. These are satisfactory in every respect, and the difficulty in holding the anvil secure is solved. All noise and vibrations when the anvil is struck are stopped, and its general appearance is very neat. The anvil is made fast to a mass of concrete, of broken stone and cement encased in a rectangular shaped box 18 inches high made of cast iron ⅝ inch thick, with a base 14 x 18 inches tapering up to 8 x 10 inches at the top, being 1 inch larger, inside measurement, than the base of the anvil. The anvil, as stated, rests upon the concrete 2 inches below the top of the casting. On each side (front and back) of the anvil, embedded in the concrete to a depth of about 3 inches, is a bolt and nut, the nut projecting up to nearly the top of casting, and about 1 inch above the concrete. On the top of this concrete melted lead is poured (filling up this space between the base of the anvil and the top of the casting about 2 inches) which flows all around the anvil, the nut of the bolt, and into the corners of the casting. The taper of the casting together with the nut holds the lead to the cement, and this it is evident, holds the anvil firmly.



Improved Anvil Block.

Several methods have been thought of, such as having the anvil rest on a box of sand, mounted to wooden and concrete blocks by means of bands of iron, hook bolts, staples, etc. All these devices failed to give the result desired. It was found that by placing 1 inch or more of the base of the anvil in a tub of water, it lost its ringing sound, the vibrations ceased altogether, and the sound when struck with a hammer was dead, so to speak, as much so as the so-called noiseless anvils made of cast iron. The base of the anvil rests on the concrete, and is gripped by the lead. This arrangement stopped completely, just as the water did, all vibrations which,

however pleasing they might be to the country blacksmith and to *some* students, are not desired in a college building. The cost of this method of mounting anvils should exceed but little the cost of anvils mounted in the usual way on wooden blocks with straps of iron, etc.

J. H. DE GROODT.

New York.

AN EXPANSION CHUCK FOR THE VERTICAL MILL.

Editor MACHINERY:

The cuts show a chuck for handling a brass-lined gray iron cylinder on the vertical mill. These cylinders, Fig. 1, are bored by a gang cutter and a brass tube is then forced and rolled into them, consequently they vary somewhat in internal diameter. This, together with the brass lining, makes

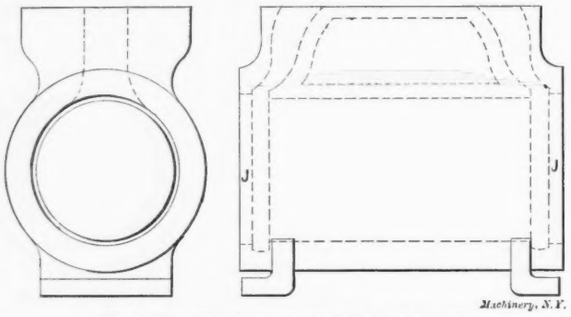


Fig. 1. The Cylinder to be Chucked and Faced.

it impracticable to put them on an ordinary arbor for facing the ends, *J*, of the cylinder, but the chuck shown in Figs. 2, 3 and 5 handles them to perfection.

Fig. 2 shows the chuck body, which is of gray iron, turned at *A* about 7-16-inch smaller than the bore of the cylinder,

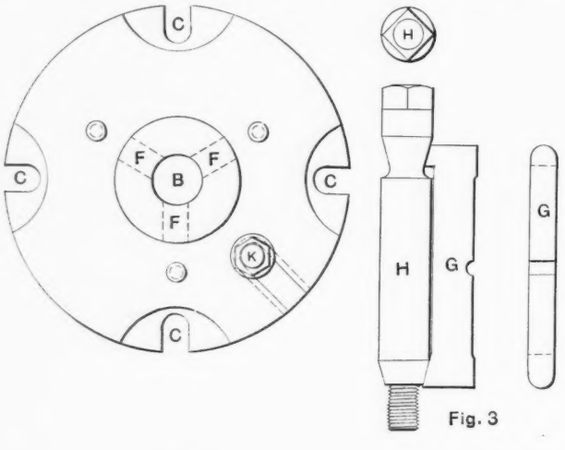


Fig. 3

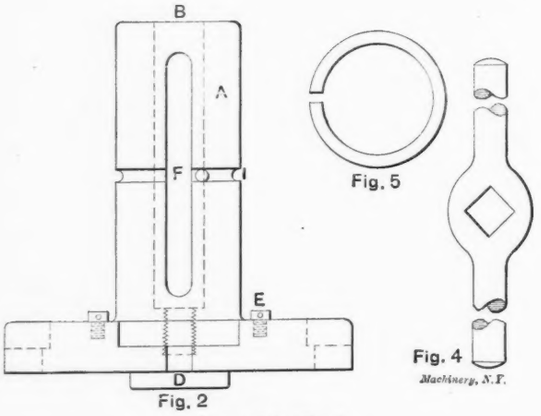


Fig. 2

Fig. 5

Fig. 4

Machinery, N.Y.

Parts of the Chuck.

and bored as at *B*; an 8-pitch thread is cut at the bottom of the bore. The four slots, *C*, are milled into the flange of the body for the bolts which are to clamp the chuck to the machine table. *D* is a boss turned on the under side of the flange to nicely fit a corresponding counterbore in the machine table, and *E* represents one of three hardened pegs for the cylinder to rest on. *F* is one of the three equi-distant slots which are end-milled into the chuck body to receive the jaws shown at *G*, Fig. 3. At *H*, Fig. 3, is shown the center piece, which is made of tool steel, hardened and ground all over to fit nicely in the bore of the body. *H* is tapered at two places, about 25 degrees included angle, threaded at the lower end to fit the thread at the lower end of the bore in the chuck body, and squared on the top to engage with the wrench shown at Fig. 4. The jaws, *G*, Fig. 3, are made of machine steel shaped out on one side to fit the center piece, then placed in the chuck body and turned to size. These jaws are relieved in the center of the outside edge to avoid "bellying" when casehardened. Fig. 5 shows a spring made of drill rod for holding the jaws snugly against the center piece, the jaws having a groove cut in them to receive the spring. The chuck body, Fig. 2, also has a groove cut into it to allow the spring to close in with the jaws, and a pin is driven in at *I* to prevent the spring from turning and getting "straddle" of a jaw. The spring is flattened off on the outside diameter to clear the bore of the cylinder.

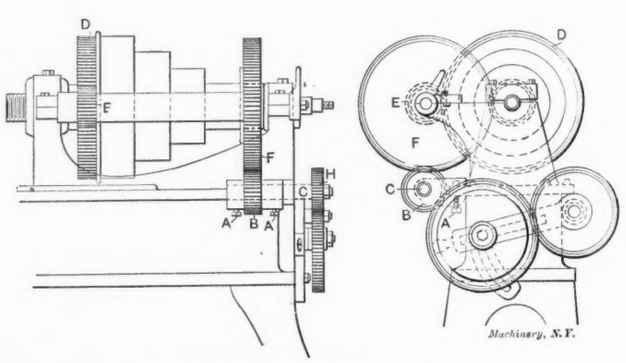
This chuck is practically dust and dirt proof and trues up the cylinders very nicely, regardless of their variation in bore. In fact it works so nicely that we now bore the ends of the cylinders, *J*, Fig. 1, to fit the cylinder heads on the vertical mill instead of making it a special operation on another machine. The operation of the chuck is very simple. To adjust it, screw the center piece down with the wrench until the jaws expand to fit the cylinder. After the cylinder is finished, a turn or two to the left frees the work so that it can be lifted off the machine and another piece placed in position. Of course we do not depend on the jaws to drive the cylinder, but accomplish this with a driver, *K*, Fig. 2, to accommodate which a T-slot is milled in the chuck body.

UNCLE JOSH.

LATHE GEARING FOR QUICK PITCHES.

Editor MACHINERY:

The following describes a method of fixing an ordinary, medium-sized engine lathe for cutting coarse-pitch screws or worms. In most shops the change gears are compounded to gain results, but my device consists simply of a bracket which is slipped over the top flange on the lathe bed and is held in place when in use by two screws. The gear *B* is made of the proper size to give the desired number of revolutions to shaft *C* in ratio to the lathe spindle. Suppose, for instance, gear *D* to have 72 teeth; the pinion *E* on the back gear shaft or sleeve to have 18 teeth; and the large gear on the back gear sleeve, *F*, 66 teeth. If it is decided to make the small shaft, *C*, revolve 12 times to one of the lathe spindle, then gear *B* should have 22 teeth. The end of shaft *C* is made to fit the change gears and bring them in line with the gear placed on



Lathe Gearing for Quick Pitches.

the leadscrew. If the leadscrew is ¼ inch lead, or four threads to the inch, and if it is desired to cut a worm of 2 inches lead, one thread to 2 inches, the leadscrew would revolve eight times to one turn of the lathe spindle, while the small shaft, *C*, would revolve 12 times. Hence the ratio of

gears would be 8 to 12, or 2 to 3, so that we could use, say, a 48-tooth gear on the end of shaft *C* at *H*, and a 72-tooth gear on the end of the leadscrew. This arrangement allows the use of a fair-sized gear as a driven gear on the screw, and gives more chance for heavy cuts without danger of stripping the gears. It is easy to see that by using an 80-tooth gear on the shaft *C* and a 40-tooth gear on the screw, the ratio of turns of leadscrew to lathe spindle would be 24 to 1, and a ¼-inch pitch leadscrew would cut 6 inches lead or 1 thread to 6 inches, and still have a fair-sized gear on the screw. I have used this device on a 24-inch swing lathe and cut 3-inch lead worms easily.

J. T.

AN EXPERIMENT WITH GAS.

Carroll Ashley.

Editor MACHINERY:

Oftentimes persons dig for gold and find sand; other times they dig up the unexpected, and find it is better or worse than anticipated. So it is in the experimental room; we start in to develop a mechanical movement perhaps, and before it is finished and even after its functions are found correct, we find it will not exactly do for this or that particular machine, and we lay it aside. Sometimes it is dug up and incorporated into something different. That is how this "experiment" with gas turned out.

When the Cochrane-Bly Machine Works moved into their new shop, they were compelled to be without gas until 'steen feet of snow could be melted from the earth's surface, so they had to substitute gasoline torch soldering. This was a poor way to do the work, as the flame, though hot enough, was too large, and melted the parts to be soldered before amalgamation took place. We finally decided to make an alcohol burner of the atomizer type.

We had a foot-bellows, which we used in connection with our gas burner, and assuming that alcohol becomes a vapor upon its exposure to the atmosphere, we proceeded to make the apparatus shown in Fig. 1. It consists principally of brass tubing, excepting the nozzle, which was turned to drive into the end of the larger tube—the dotted lines show the appearance of the opening—and a glass bottle at the other end was filled three-fourths full of alcohol. In the smaller tubing

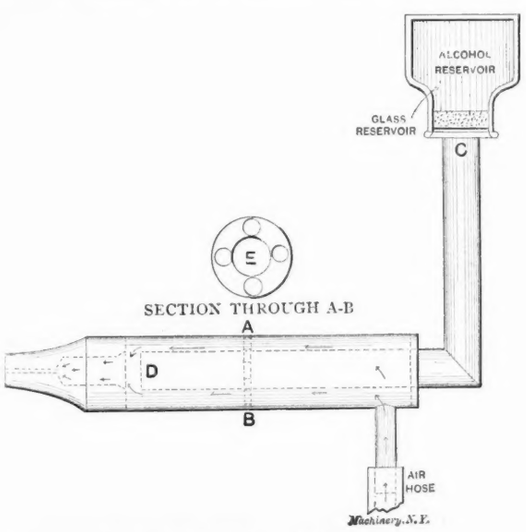


Fig. 1. First Experimental Alcohol Burner.

from *C* to *D*, waste was packed tight, being freely soaked in alcohol. The piece *E* had five holes, a large one in the center to support the small tubing equidistant from the walls of the larger tube, and four smaller holes for air passages. This piece was a drive fit and its location in position is shown by dotted lines through the section *A B*. The air, following the direction of the arrows, was supposed to unite with the alcohol at the end of the small tube at *D*, Fig. 1, and when forced out the nozzle, was expected to ignite from a match into a "dandy" blue flame.

All being ready, foot power was turned on the bellows and numerous matches were lighted in anticipation of the result. From a spectacular point of view, it was a burning success, though not at first—not until the contents of the reservoir had dripped through into the larger tube; then an overflow

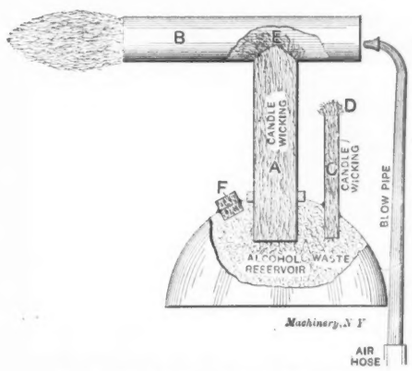


Fig. 2. Final Form of Alcohol Burner.

meeting was held and blue flame by the yard expectorated, and I expect that identical experiment ended then and there.

But we decided we could make better fireworks, so we built another burner like Fig. 2. First taking the bottom of an oil can and stuffing it full of waste, the brass tubes *A* and *C* were soldered in as shown. Through these tubes candle-wicking was drawn. At the top end of the tube *A* another tube *B* was fitted, tube *A* being driven into an opening at *E*. At *F* was a hole fitted with a cork to permit refilling. A blow-pipe soldered in a permanent position, with the small end nearly central to the open end of tube *B*, served also as a handle to hold the burner. This arrangement of these tubes was not our first attempt at this style of a burner, but after persistent experiment it was found that the form shown in Fig. 2 was the desired article—that is, in so far as it went.

To start this torch the wicking in tube *C* is lit, its functions being to heat the tube *B*. The alcohol gathered at *E* immediately forms a gas which ignites and comes out of both ends of B, but as soon as air is forced into and through the blow-pipe, the flame is emitted from the opposite end from the blow-pipe, in a roaring, very green flame, which is somewhat hotter than that of the gasoline torch. It was no better for our purpose, however, than the gasoline torch, because the flame could not be controlled, that is, focused to a small point. It would be very handy for drawing the temper in broken taps and to my mind is much safer than gasoline. The tubes *A* and *B* were ⅝ inch by 5 inches long, and the small tube *C* was ⅜ inch by 3 inches long, substantially as described.

CARROLL ASHLEY.

Rochester, N. Y.

Carroll Ashley was born in Tallmage, Ohio, June 13, 1871. He received a common school education and took a scientific academical course of three years. He served his apprenticeship with the Noble Sewing Machine Company, Weeping Water, Nebraska, and has worked for the Lozier Mfg. Co., the Snell Cycle Co., the Meilink Mfg. Co., the Toledo Machine and Tool Co., the Tally-Ho Cycle Co., B. F. Bellows, the Eastman Kodak Co., and the Cochrane-Bly Machine Works. Mr. Ashley has done much experimental work and designing, and this is the work which he considers to be his specialty.

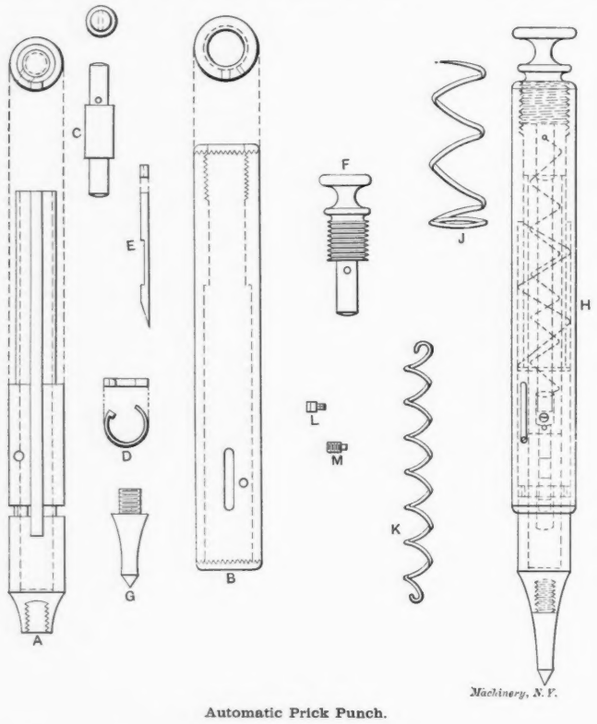
AUTOMATIC PRICK PUNCH WITH ADJUSTMENT.

Editor MACHINERY:

The automatic prick punch recently put upon the market by the Brown & Sharpe Mfg. Co. recalls to my memory one that I made several years ago. From the view of the punch and working parts shown full size in the cut (next page), it will be seen that its construction is in no way similar, and that it has the superior feature of adjustment by which the force of the blow can be regulated.

The parts *A* and *G*, when assembled, form the prick punch proper. *D* is a snap lock made of spring steel, which snaps into the groove on *A*, allowing the catch at one end to enter the square hole in the bottom of the groove. When the catch enters the hole to its full depth, it engages the hammer, *C*, as

it passes down in the bore, but *E* is a wedge fitting in the spline shown in *A*, the point of which passes under *D* and acts as a trip by which the hammer is released. The lower point of *E* is designed to be at all times under the full width of *D*, the retracting spring, *J*, preventing it from becoming disengaged. A small screw or pin screws through the sleeve, *B*, and engages the notch cut in the side of *J*, by which the latter is moved as the pin strikes the shoulders. The screw or pin holding the wedge must not bind on it, as it only moves about 3-32 inch, while the sleeve moves about 5-16. In operation the point is placed against the work, causing the sleeve to move downward on *A*. The catch *D* engages the shoulder of the hammer, *C*, compressing the small spiral spring, *K*, As the sleeve nears the lower end of its movement, the pin striking the shoulder of the notch in *E* pushes it further under *D* and releases the hammer, allowing the latter to strike the bottom of the hole in which it works, thus punching the work.



Automatic Prick Punch.

The hammer passes the catch freely on its upward movement, since the catch enters the hammer cavity only after the wedge, *E*, has been moved upward by the upward travel of the sleeve. The force of the blow is adjusted by the adjusting screw, *F*. In assembling the tool the retracting spring, *J*, the larger of the spiral springs, is slipped on the small end of *A*, after which the knurled sleeve, *B*, is slipped over *A*, and the two tightly fitting screws shown at *L* and *M* are screwed into place.

This tool was not designed to strike a hard blow, but is most useful in working at fine work; if a tool of more power is required it may be obtained by putting in a heavier hammer, or perhaps a stronger trip spring.

New Haven, Conn. OTIS D. STORER.

CHECKING A DRAWING.

Editor MACHINERY:

It may be interesting to your readers to hear of some methods used in checking drawings. In the following I have first given a description of a method in general use, and then described a system I have used, explaining what I think to be its advantages over the usual method.

In checking drawings for a machine, the first thing to be done in all cases is to get the general arrangement, and to check the center distances and elevations with the principal dimensions given on the details. After the principal dimensions on the general drawing have been checked, it is used as a lay-out for the details. Each dimension on the detail is checked, and if a similar detail has been used on some other machine in order to establish a standard the new one should be made proportional to the old. Finish marks are noted on details where required, and none on surfaces that do not need it, for any finish that can be saved lessens the time in the machine shop. Sizes of all bolt holes are marked and the bolts to be used are called for or noted. Every piece on the drawing, either called for or shown, must be given a letter or pattern number, and the number of pieces required for each drawing ordered. If a certain radius for curve is used in one place, the same radius should be used in each similar place. Care must be taken in checking that standard pieces are used as far as possible, especially in slots for bolt heads. If a slot is made so wide that a standard square head bolt turns in it, a special bolt is required; while if the slot had been made narrower a standard bolt from stock would have answered the purpose just as well. Whenever practicable, the pieces of a machine should be made so that one can be removed without disturbing the other, this saving a great deal of time when making repairs. As few patterns as possible should be made and often, with a little foresight, one pattern can be made to answer in two or three places by making some pieces loose so that they can be changed around to suit different conditions. Great care must be exercised that there are no interferences. These can best be detected on the general arrangement and by laying in the adjacent machinery.

In most drawing rooms, when checking, the tracing is used, and all the changes are noted on the tracing with a pencil—blue, red or black, as the draftsman prefers, while the correct figures are checked with ink. After the man who made the drawing has approved the indicated changes the tracer makes them without erasing the pencil marks. The drawing is then returned to the checker, who checks off the changes that have been made. As he checks them off in ink, he cleans the tracing with a sponge rubber and anything the tracer may have missed the checker finds during this operation. All figures on the drawing must be clear, so that there can be no doubt in the shop as to the intended dimensions. The pattern and drawing numbers must be looked up to see if the records have been made out properly and after the detail drawings are all checked the general drawing can be finished. All the pattern numbers are noted and the principal pieces marked with their particular mark and drawing number.

I have checked a great many drawings, however, and find that a much easier and better way is to take a print of the tracing to be checked. All corrections or changes are indicated on this print with red pencil, and all figures that are right are checked with yellow pencil. The changed blueprint is given back to the draftsman and he and the checker go over it and decide which is the correct figure or the better way to do the work. After all changes have been approved, the tracer makes the corrections indicated in red pencil. When this is finished the checker compares the tracing and the blueprint to see if all changes have been made, and if he finds the dimensions on the tracing correspond to the red ones on the print, he checks those on the print with a blue pencil, marks the tracing "checked," and the checked blueprint is filed. If the work does not go together properly in the shop the chief draftsman can produce the checked blueprint, see if the dimensions have been overlooked or improperly checked and so know where to place the blame. When a drawing is checked by this method no check marks show on the tracing, but it is marked in one corner: "Checked by ——," and the date given when checked.

With the first method, it is not unusual for a drop of ink to fall on the tracing or for some of the check marks to be blurred. The checker must then spend quite a little time in cleaning off the drawings, a waste of labor which is obviated by the latter method. If there are a large number of drawings for the machine, the tracings in the first method get very badly soiled and crumpled, it being necessary to have them all on the table during the entire process of checking, which often occupies a week. In the latter method, however, the tracings are out only while the tracer is making the necessary changes and while the checker looks them over to see if they are correct. JULIAN D. PAGE.

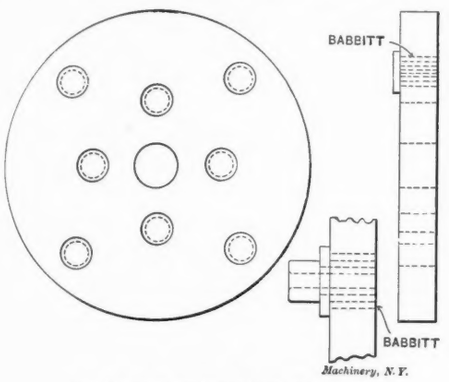
Youngstown, Ohio.

METHOD FOR MAKING DRILL JIGS.

Editor MACHINERY:

I am prompted to describe a method I have for making large ring jigs and other large jigs in general having a large number of holes to be spaced very accurately.

The sketch will give you an idea of what I mean. I take a ring jig as it comes off the boring mill, lay off the holes according to specifications and drill the bushing holes, making them ⅜ or ½ inch larger than the outside diameter of the bushings. These are made of cast iron or soft steel as the case may be, with a shoulder ⅜ or ½ inch thick, the shoulder being wide enough to receive two screws and two dowel pins. The hole in each bushing is drilled and reamed to receive the drill, reamer or tap bushings, as usual.



Drill Jig with Bushings fixed in Babbitt.

The bushings being ⅜ or ½ inch smaller than the holes in the drill jig they can be shifted in any direction. I now place the bushing in the proper holes, approximately in the right place, lay off and drill the screw holes, put in the screws and fasten them. I then rap the bushings to the exact position, finally securing them with the dowel pins. To insure permanent position and solidity of the bushings, the jig can be turned over and the open space around the bushings filled with babbitt.

I have found this method to bring good results; a jig that has a lot of large holes drilled into it is very likely to spring out of shape. I once made a large ring jig containing twenty 3½ and 4-inch holes. After drilling them all, I tested the plate for trueness and found that one side had dropped fully 1-32 inch, so if one was required to be very accurate the jig could, after drilling, again be put on the boring mill and faced true; this would insure all holes being parallel. This method can also be used in altering holes. I once made a jig for a gearbox and through an error in the drawing room, two gears were meshed too close, which by the way was not discovered until the machine was being assembled. I then used this method to correct the error. N. J. W.

"TABLE OF SPUR GEAR TEETH, GIVING DIAMETRAL PITCH": A CORRECTION.

Editor MACHINERY:

I thank you for calling attention to the error in my article on gearing in the December issue of MACHINERY. It occurred in the example given where I carelessly took the speed of the pinion when I should have taken that of the gear; but as the error affects all the work following, I will ask to give a new example.

Example: Suppose we were designing a machine in which a belt wheel, running at 200 R. P. M., is to drive a shaft whose pinion meshes with a gear running at 25 R. P. M., and suppose we know, either by calculation or experiment, that the force or load on one of these gear teeth is 750 pounds. What are the proper dimensions of the gear blanks, and what size pulley should be used, the distance between the shafts being 18 inches?

The velocity ratio is 200 to 25, or 8 to 1. The sum of these ratio terms is 9. The diameter of the gear, on the pitch line, would therefore be $2 \times {}^{8}/_{9} \times 18 = 32$ inches. Its tooth velocity would be $\frac{32 \times 3.14 \times 25}{12} = 209$, say 200 feet per minute. The load we already know to be 750 pounds. Now, from the table, we see at once that the diametral pitch corresponding to the 200-feet velocity and the 750-pound load, is 4; and, in the same square, we observe the horse power to be 4½. The width of the face being "8 divided by the pitch as found" is ${}^{8}/_{4} = 2$. The outside diameter of the gear blank, by the well-known formula, is 32 plus ${}^{2}/_{4} = 32\frac{1}{2}$ inches. The pinion blank, by the same reasoning, is 4½ inches diameter by 2 inches, say 2¼ inches face. The number of teeth in the wheels are, of course, readily calculated, knowing the diameters and the diametral pitch.

To find the dimensions of the pulley, we have given in the table the H. P.—4½, as above stated—and we have then simply to apply some belt formula such as $\text{H. P.} = \frac{\text{D R W}}{2750}$, when, if we choose a 3-inch belt, the diameter of the pulley becomes 20.6, say 20 inches.

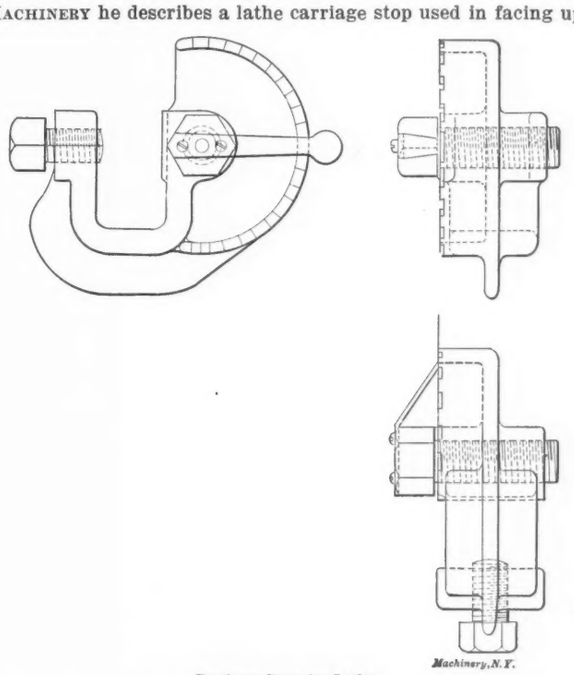
The horse power, as given in the table, is equally convenient in calculating the sizes of the shafts, that is to say, the bores of the gears. The table will be found convenient also in modifying the orginal tooth-face in case it is desirable to use a different pitch from that given in the table, as for instance: When the new pitch can be found in the same horizontal line in which the original pitch is found, that is to say, having the same tooth-speed, it is simply necessary to multiply the tooth-face, corresponding to the original pitch, by the ratio of the two horse powers corresponding to the two pitches (the original horse power being the numerator) and the new face gives a tooth equal in strength to the original tooth. Suppose, in the 32-inch gear, that it were desirable for other reasons to use a 5-pitch instead of the 4-pitch, the original face being 2 inches. The horse power corresponding to the original pitch, 4, is seen in the table to be 4½, and that corresponding to the 5 pitch (in the same horizontal line) is 3; the required face is therefore the original face multiplied by this ratio, or $2 \times \frac{4.5}{3} = 3$ inches. This tooth, then, is as strong as the original one 2 inches wide. When the new pitch is found several times in the same horizontal line the average of the corresponding horse powers may be taken.

Worcester, Mass. L. S. BURBANK.

CARRIAGE STOP FOR LATHE.

Editor MACHINERY:

In the article by "Steel" published in the November issue of MACHINERY he describes a lathe carriage stop used in facing up



Carriage Stop for Lathe.

piston rings which, while it no doubt answered the purpose very well, would seem to be a makeshift that a shop with an experience of forty-seven years ought not to be content with, the

more so as there are so many jobs where substantially the same method may be used to advantage.

In the sketch I have suggested a plan for making a stop for this purpose which will soon pay for itself in time saved, especially should there be a spell of windy weather when the slips of paper might frequently blow away.

The stop screw is an ordinary ¾-inch hexagon head cap screw with a pitch of 10 threads to the inch so that one-half turn advances it 0.050 inch. By graduating the sector as shown to ten equal divisions a movement of 0.005 inch is obtained so that the finishing cut may be taken of that thickness or any multiple up to 0.050 inch. The spring lever serves to turn the screw easily and affords a positive stop for keeping it in position.

J. A. WEBSTER.

Brooklyn, N. Y.

STRIKING UP FORMING DIES.

Editor MACHINERY:

The casual observer seldom thinks of the trouble it is to get the fasteners on gloves, suspenders, etc., finished so that they will act just right when in use. To look at them it seems as though all that is required is to set them any old way, so long as they will hold, but this is far from the truth.

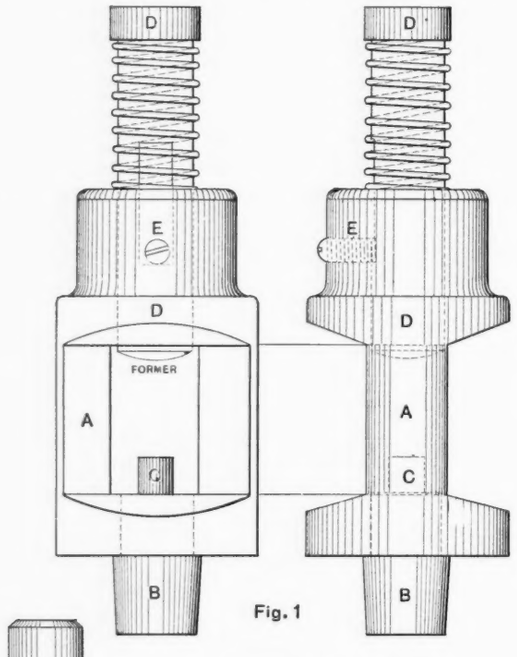


Fig. 1

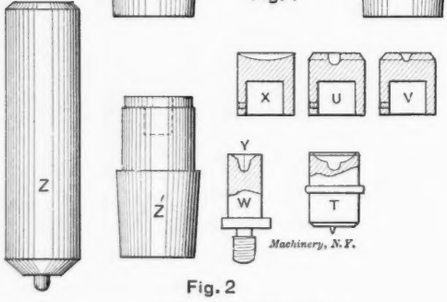


Fig. 2

Striking up Forming Dies.

In applying these fasteners to light, or thin goods, if the dies set them so that they snap hard, the goods soon tear in trying to open them.

Sam was given charge of the making of the setting dies for this work. Now these dies were all made with forming tools and had to be fit to gages; and were polished with emery cloth afterward by apprentices. It frequently happened that the boys held the emery cloth too long on some of the dies and when they were put in use, this made so much variation in the work turned out as to cause trouble.

Sam became tired of this and adopted a scheme that stopped all trouble from this source. Fig. 1 shows what you might call a small forming press or sub-press. This was used under a drop, which was controlled by the foot. *A* is the body of the forming press. *B* is a taper plug which fits tight in *A*, the taper end fitting in the anvil of the drop. *C* engages the die when being struck up by the hob *D*. A die similar to *X*, or any of that class, Fig. 2, is placed on the stud, *C*; the drop is then raised to the height required and dropped on *D*, which descends on the die and produces an exact shape. The spring raises the hob *D* so that the finished die can be removed and another inserted. The screw *E* stops *D* at the proper height. In striking up a die like *W* the parts *Z*, *Z'* are used. The blow required to form *W* is so slight that it was not necessary to use the drop. A plain hole was drilled at *Y* and a light hand hammer was all that was necessary. With a slight experience the right blow can be easily gaged, so that the dies all came out alike. Of course different hobs were made to suit the various shapes, a few of which are shown in Fig. 2.

PEDRO RE.

MILLING A LARGE SCREW.

Editor MACHINERY:

One afternoon while wandering through the machine shop connected with our plant, the Atlas Portland Cement Co., Northampton, Pa., I came across a job that made a great impression on me. On the floor lay several screws 14 feet long and 6 inches in diameter, with a lead of 6⅝ inches. In a 48-inch Fitchburg lathe beside them another was being milled out with two cuts at a rate that filled me with astonishment. Almost any draftsman could design a machine for doing this work if given time and money enough, but the master mechanic of this shop, Mr. Robert McClellan, in addition to keeping a very large plant in repair and building a good deal of special machinery for two other plants under construction, had devised the rig for doing this job from material found in an ordinary repair shop. Scarcely a part used had been made new, and the ingenuity shown in getting it together deserves the greatest credit.

At three corners of the lathe carriage were erected pieces of "two by four" and at the fourth corner a structural angle was used for some reason which I have forgotten. Across these uprights other pieces of joist were laid and well braced, and on these a countershaft was mounted. A 5-horse-power motor was placed at the rear of the carriage and belted to the countershaft. The regular tool block was removed and the head from a vertical milling machine substituted. This carried an end mill which could be adjusted up and down, and fed in and out by the regular cross-screw in the carriage. The mill was driven by a belt from the countershaft, a suitable belt-tightener being provided. The regular traverse rest was used but a jackscrew was placed between the carriage and one of the jaws for taking the downward thrust.

The lathe was geared up to give the right lead, the triple back gears were thrown in and the belt thrown onto the largest sheave of the cone pulley. The current was now turned on, the mill fed in to the right depth, the lathe started up, and the job commenced. The thread was of about 1¼ inches cross-section with large fillets at the bottom. Two cuts only were taken to remove all the stock, since, for the work the screws had to do, it was not found necessary to remove the scale from the outside of the bar. If I remember rightly, the speed of the cutter was 40 feet per minute, its diameter being about 2½ inches. It made 60 revolutions per minute. The rate of feed was about 1¾ inches per minute, and the depth of cut about 1¼ inches, less than a day being required to finish a screw.

Rutland, Mass. H. A. HOUGHTON.

METHOD FOR BURNISHING BALL CASES ON INTERNAL BEARINGS.

Editor MACHINERY:

The writer, knowing the ever-increasing tendency of manufacturers to adopt the ball bearing ideas on their machines and products, is now giving what his experience in such matters has shown him to be successful, the methods described in the following having been adopted and used on many thousand machines. The originality of the system he feels to be his own, and the superiority over the old system of shaving ball cases with a single blade is without question. In making

ball cases I have found that in the "cupping-out" process, it was almost impossible to get as smooth a cut as desired by the single blade method, and after several attempts to overcome the crude conditions, the methods as explained in this article were adopted. I have found it hard to hold the case when

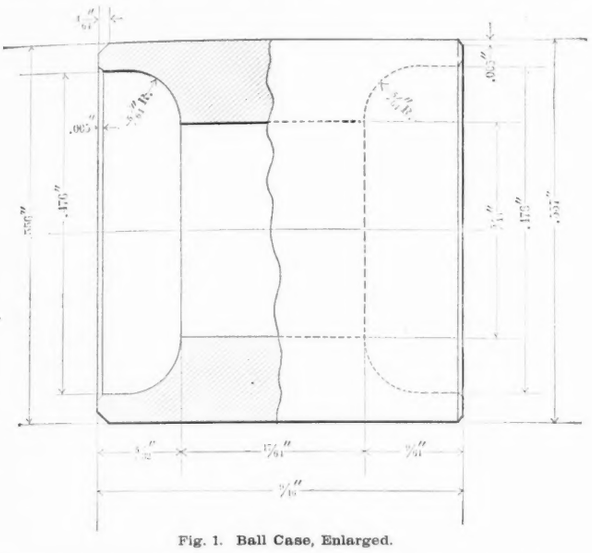


Fig. 1. Ball Case, Enlarged.

desirous of cutting to size, and especially was it so when a "cup-out" at each end was wanted to get the two diameters to run true with the hole in the case, or with the outside diameter as shown in Fig. 1. This method is as follows:

Drill and ream hole of case, and cut off to length on automatic screw machine; then place the case in a spring chuck in a

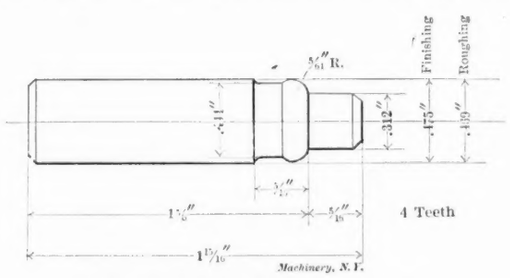


Fig. 2. Roughing and Finishing Counterbores.

hand screw machine for cupping. The tools necessary for the process of cupping and burnishing consist of roughing counterbore, finishing counterbore, and burnishing tool. The roughing and finishing counterbores each have a tit on them to fit the 5-16-inch hole in the ball case. These are used in a floating holder, to float with hole in case, and are made as shown in Fig. 2.

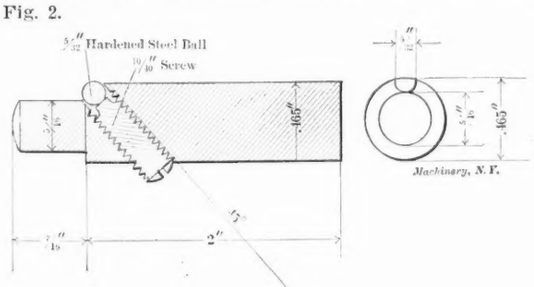


Fig. 3. Burnishing Tool.

After roughing, the finishing counterbore is used, which is made to cut 0.00025 inch undersize; by that I mean for the cupped hole to be that much smaller for the burnishing tool to burnish. This tool is shown in Fig. 3. It also has a tit which fits the 5-16-inch hole in case, and is used in a floating holder. The ball in the burnishing tool should be the same radius as the ball race, or a little over-size.

Some of the readers of this article will probably think that when the ball case is finished to size and hardened it might be out of true. The Underwood Typewriter Co. have over forty thousand such ball cases on their machines, and the writer has not had one-half dozen defective, even these being ground to size on the outside diameter of case for required fit to casting into which they are placed. When the ball case is assembled there can be no end shake or side play, notwithstanding that there is but 0.003 inch limit for depth from outside, so that the reader can readily see that the work has to be done somewhere near right. It is obvious that the old way of hardening and grinding would be very costly, when compared with the method which is used as described above.

P. STERN,
Underwood Typewriter Co.

Hartford, Conn.

SOME ENGLISH INSERTED CUTTER TOOLS.

Editor MACHINERY:

John C. Hafner.

Fig. 1 shows an inserted tooth-milling cutter which has given very satisfactory results. This was originally made in a great hurry for facing the bottom of pedestals, but it is now used for a variety of rough work. It is 15 inches in diameter and has sixteen ¾-inch diameter high-speed steel cutters, each held in position by a ½-inch diameter square-headed screw and adjusted by a grub screw from the back. The body, which is light but plenty strong enough, is made of cast iron and is threaded to suit the spindle nose of the milling machine. It is simple and inexpensive to make, and the idea will, I think, be plainly seen from the sketch without the need of further description.

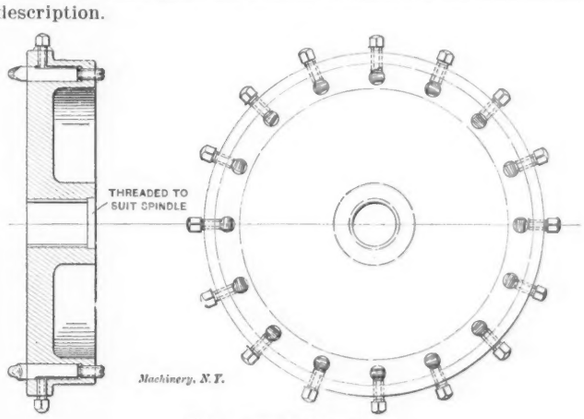
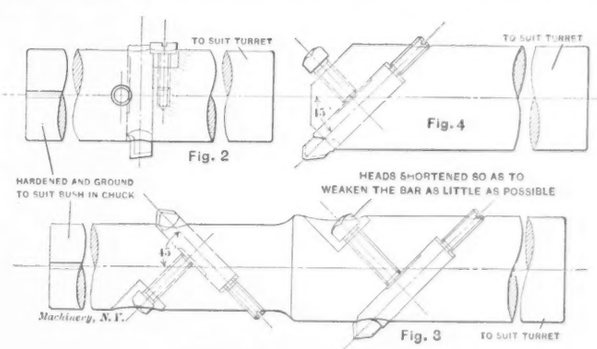


Fig. 1. Inserted Cutter Mill.

It is the usual procedure when boring castings, etc., in the turret lathe to rough the holes out with a single-point boring bar and to finish them with a bar having a flat cutter. If greater accuracy is required, a reamer is put through, an ad-


TO SUIT TURRET
Fig. 2
TO SUIT TURRET
Fig. 4
HARDENED AND GROUND TO SUIT BUSH IN CHUCK
HEADS SHORTENED SO AS TO WEAKEN THE BAR AS LITTLE AS POSSIBLE
Machinery, N.Y.
Fig. 3
TO SUIT TURRET

Inserted Cutter Boring Tools.

justable floating reamer giving very good results. The tools used for this operation, of course, depend upon the diameter

JOHN C. HÄFNER was born at Lincoln, England, March 5, 1882. He attended evening classes for five years at the Technical School and the School of Art. He served an apprenticeship (not articled) with Allday & Onions, Birmingham. After serving his apprenticeship, he worked for Charles Taylor & Co., Alfred Herbert & Co., and Vickers Sons & Maxim. He is a draftsman, designing small tools, jigs and fixtures.

of the hole being bored. The majority of single-point boring bars that I have come across, however, have no means for adjusting the cutters. The most common type appears to be the one in which the cutter is held in position by a hardened pin driven into the bar at right angles to the axis of the cutter and bearing upon it. Fig. 2 shows a bar of this type, but with a screw for adjustment, the head fitting into a notch in the cutter. Whenever possible, I try to avoid holding these cutters in position by means of pins driven in, for the cutters require frequent grinding, which necessitates removing them from the

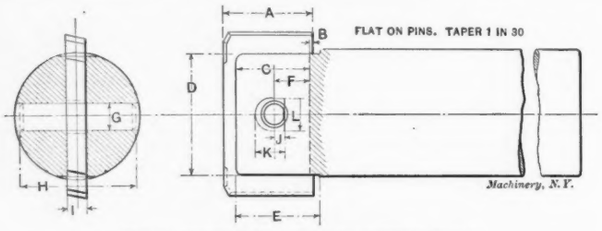


Fig. 5. Inserted Cutter-bar for "Blind" Holes.

bar, and this knocking in and out always seems to me an unsatisfactory business. There can be no doubt that when the cutters are not adjustable much time is lost in resetting. Fig. 3 shows a bar in which the cutters can be quickly removed by simply slackening the square-headed screw; or for small bars, a grub screw may be used, which is sufficient to hold the cutter firmly in position. To obtain good results, it is best, especially where boring long holes, to support the front end of the bar, preferably in a hardened steel bush held in the chuck. It is not always possible to support the bar, however, since the holes being bored do not always go right through the piece, and for such "blind" holes the bar shown in Fig. 4 answers all

LIST OF STANDARD BORING BARS.

Diam. of Bar.	A	B	C	D	E	F	G	H	I	J	K	L
3″	1 7/8″	1/16″	1 5/8″	2 7/8″	1 3/8″	3/4″	9/16″	2 3/4″	1/2″	1/8″	5/16″	1 9/32″
2 7/8″	1 3/4″	1/16″	1 1/2″	2 5/8″	1 5/8″	11/16″	1/2″	2 1/2″	7/16″	1/8″	9/16″	1 17/32″
2 3/4″	1 5/8″	1/16″	1 3/8″	2 3/8″	1 1/2″	11/16″	1/2″	2 1/4″	7/16″	1/8″	9/16″	1 17/32″
2 5/8″	1 1/2″	1/16″	1 1/4″	2 1/4″	1 3/8″	5/8″	7/16″	2″	3/8″	1/8″	1/2″	1 15/32″
2 1/2″	1 1/2″	1/16″	1 1/4″	2 1/8″	1 3/8″	5/8″	7/16″	1 7/8″	3/8″	1/8″	1/2″	1 15/32″
2″	1 1/8″	1/16″	1″	1 7/8″	1 1/4″	9/16″	3/8″	1 5/8″	5/16″	3/32″	7/16″	1 13/32″
1 7/8″	1 1/8″	1/16″	1″	1 3/4″	1 1/4″	9/16″	3/8″	1 5/8″	5/16″	3/32″	7/16″	1 13/32″
1 3/4″	1 1/8″	1/16″	1 1/16″	1 5/8″	1 3/16″	17/32″	5/16″	1 1/2″	1/4″	3/32″	3/8″	1 11/32″
1 5/8″	1 1/8″	1/16″	1 1/16″	1 5/8″	1 3/16″	17/32″	5/16″	1 1/2″	1/4″	3/32″	3/8″	1 11/32″
1 1/2″	1 1/8″	1/16″	1 1/16″	1 3/8″	1 1/16″	15/32″	1/4″	1 1/4″	1/4″	3/32″	5/16″	1 9/32″
1 3/8″	1 1/16″	1/16″	1″	1 1/4″	1″	15/32″	1/4″	1 1/8″	1/4″	3/32″	5/16″	1 9/32″
1 1/4″	1″	1/16″	15/16″	1 1/8″	15/16″	15/32″	1/4″	1″	1/4″	3/32″	5/16″	1 9/32″
1″	7/8″	1/16″	13/16″	1″	13/16″	13/32″	1/4″	7/8″	1/4″	3/32″	5/16″	1 9/32″

right. The cutter is held in position and adjusted in the same way as in Fig. 3, and with this bar a hole can be bored up to a shoulder, since the cutter projects beyond the end of the bar. Fig. 5 shows a bar with a flat cutter for finishing blind holes, and the table gives a standard list of sizes of this bar from 1 inch to 3 inches diameter. These cutters are held in position by the usual hardened parallel pins with taper flats on them. A hole is drilled in the cutter a little larger in diameter than that of the pin, one side being squared out and tapered to correspond with the taper on the pins.

Sheffield, England. JOHN C. HAFNER.

TRIANGLE FOR ISOMETRIC DRAWING.

Editor MACHINERY:

I send sketch of an appliance which will be found of use to those who have much isometric drawing to do, as for patent drawings. It consists of a triangle, Fig. 1, having two angles of 30 degrees each, and out of which is cut an equilateral triangle, one side of which is parallel to the long side of the piece. This device is kept on the upper edge of the T-square blade, and does not need to be turned over, but only slid to right or left, to make lines 30 degrees or 60 degrees from the horizontal, either to right or to left. If, furthermore, there are two sets of graduations, of which those of one set are 9-11 (more exactly, 89-109 or 1,000-1,225; or, still more exactly, 0.8165), those of the other set, the shorter divisions, serve to measure distances in the three main axial directions, as for instance the foreshortened lines, *AB*, *BC*, *CD*, *DE*, *EF*, *AF*, *AO*, *CO*, and *EO*, of Fig. 2, while the long ones serve for unforeshortened ones, such as *AC*, *AE*, *CE*, *BD*, *DF*, *BF*.

Further, the plan and elevation of objects the sides of which are isometrically drawn, may be constructed from the isometric projections by drawing on the larger scale at the 90-degree angles in plan or elevation, lines which are at the 60-degree angle in the isometric projections. Thus the plan, or elevation of the cube shown in Fig. 2, is given in Fig. 3, on the same scale; the line *AO'*, *AF*, etc., being 1.225 as long as in Fig. 2.

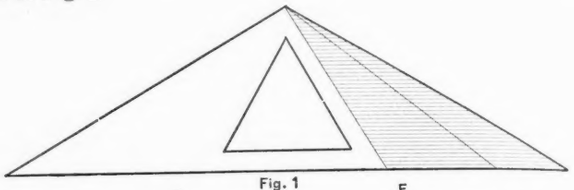
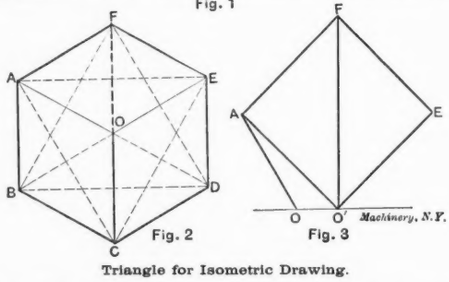


Fig. 1



Triangle for Isometric Drawing.

If the edge of the triangle has three scales bearing the relations 707, 1000 and 1225, the first gives the minor and the third the major axis of ellipses representing circles drawn according to the second, and the latter two serve as above mentioned.

Hanover, Germany. ROBERT GRIMSHAW.

THREE-PIECE ELLIPSOGRAPH: A CRITICISM.

Editor MACHINERY:

In the November, 1904, issue of MACHINERY, Mr. J. D. Adams explains how to make an ellipsograph, but to my thinking the directions and diagrams are not complete. He says nothing whatever about the slots for the center screw to move in, but merely: "The whole apparatus is held together by a large wood screw passing through Figs. 2 and 3 into the center of Fig. 1," etc. Now, if this screw is screwed in tightly, Fig. 3 cannot move, or in other words, the screw cannot move in the

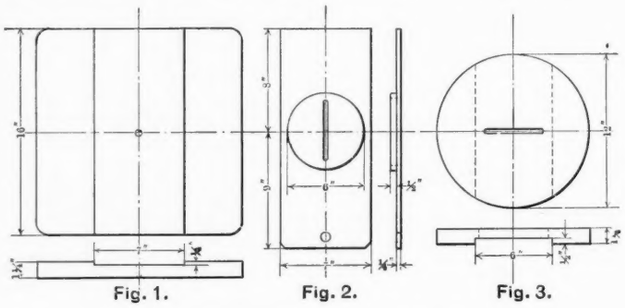


Fig. 1. Fig. 2. Fig. 3.

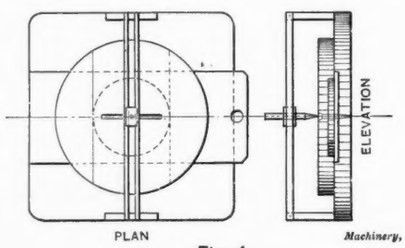
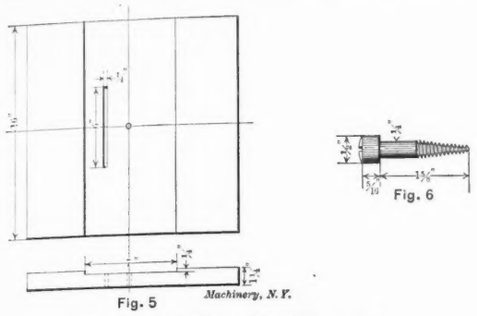


Fig. 4.

Three-piece Ellipsograph.

slot of Fig. 3, which movement is necessary to produce the ellipse. There are, however, two very simple and easy ways by which the desired result can be accomplished. One is by using the pieces as he has shown, except that there must be a slot in Fig. 1 as in Fig. 5. Fig. 2 can then be adjusted to the desired distance from the center, and fastened to Fig. 1 from the under side through this slot. The screw can then be left loose through Fig. 3 so that it can have the desired movement. A still better plan, however, would be to use

but the one screw, making some modifications in its shape and application. If the screw were made as in Fig. 6, that is, an ordinary wood screw with a filister head, and the slot in Fig. 2 made to fit the body of the screw, and the slot in Fig. 3



Improvement in Three-piece Ellipsograph.

to fit the head, then Figs. 2 and 1 could be joined solidly and still leave Fig. 3 free to rotate and slide along the head of the screw. In making this ellipsograph, I would make the slot for the screw head in Fig. 3 only part way through on the under side, so as to leave the top surface free from holes, otherwise the slot will prevent the cutting of small ellipses. In using this device, the top circular plate should be lifted off and Fig. 2 moved the distance off center required for the radius of the larger diameter of the ellipse. The screw should then be tightened and the top plate put on, when the pencil can be moved the distance off center required for the radius of the smaller diameter.

CHARLES G. TAYLOR.

Hartford, Conn.

PLANER AND LATHE CUTTER AND BORING BAR

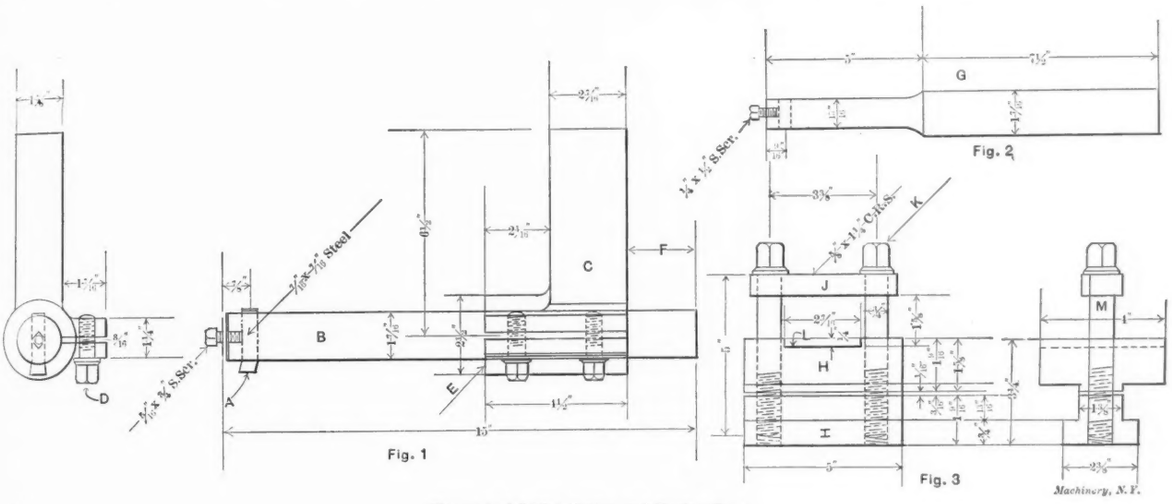
Editor MACHINERY:

The cuts show a combination inserted cutter tool which I made and found to be very efficient in the work for which it is adapted. Fig. 1 shows the tool as first constructed for cutting keyways, through long hubs, in the planer. The bar *B* is a piece of 1 7-16-inch cold rolled shafting fitted with a square hole and setscrew to hold cutter *A* as shown. The cutter bar holder *C* is a forging, bored a close fit for bar *B* and finished with the face *E* slightly in advance of the tool holding studs in clapper-box. The shank was planed all around to just fill space for tools under tool clamps, with the nuts full on studs. Screws *D* were fitted to any convenient wrench. With this bar the heaviest cuts could be taken with perfect rigidity, and the planer which was a 24-inch by 24-inch by 6-foot machine of modern make was stalled without any indication of springing or slipping of the bar. The extension *F*, under cross-rail, if properly set, prevented raising bar high enough to strike tops of holes. Fig. 2 shows another cutter bar, *G*, made to be used in small bores.

Fig. 3 shows a block which was so constructed that the tool shown in Fig. 1 could be used as a boring tool for a 24-inch Blaisdell lathe, and it needs very little explanation. The raising block *H* has a groove in the top, of the proper width to just fit the shank of *C*. A tongue on the bottom was fitted to the toolpost groove in the lathe cross-slide. The face *L* was just high enough to hold the center of bar *B* in line with lathe centers. *I* was a loose fit in bottom of toolpost slot and was tapped for the screws *K*, the heads of which were fitted to the toolpost wrench. *J* was made of a piece of 1¼ x ⅝-inch cold rolled steel. A pair of light springs (not shown) were slipped over screws *K* at *M* to hold up clamp *J*.

With this rig in the lathe, I have bored 3-inch holes, which were cored 2¾ inches, with the cut at times almost all on one side, and had good holes with one cut; but for accurate work, of course, a very light finishing cut was necessary. The use in the lathe was not a part of the original idea, but withal the whole rig when completed was well worth the money it cost to the small shop in which it was used.

A. B. C.

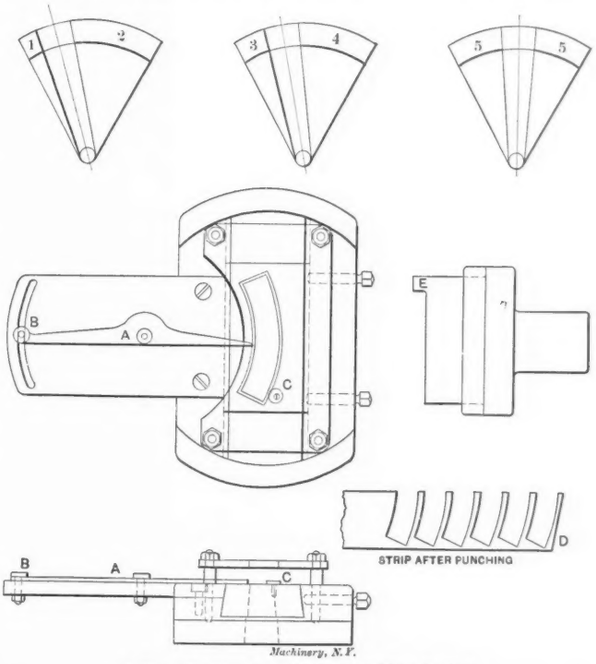


Planer and Lathe Cutter and Boring Bar.

PUNCH AND DIE, ADJUSTABLE, TO CUT SECTORS OF VARIOUS LENGTHS.

Editor MACHINERY:

I send you a sketch and description of a punch and die with an adjustable gage for producing the brass contact sectors for electrical controlling apparatus (principally crane controllers). By this method it is necessary to have only



Adjustable Punch and Die for Cutting Sectors.

one die for sectors of the same radius instead of the five or six separate dies which are usually required. It is possible that in the course of a short time this particular type of controller may become obsolete and it will, therefore, be seen how essential it is to manufacture it with the least possible outlay for tools.

The die was made somewhat larger than the largest sector to be punched and was fastened to the cast-iron bolster in the conventional way. A flat piece of machine steel which holds the adjustable gage *A* was recessed into one side of the bolster and fastened with filister-head screws. The gage itself was made to swivel about a central stud and is clamped in position by a binding bolt and nut *B* at the outer end. In the sketch the gage is shown in position to punch sector No. 5. The eccentric stop disk *C* which is held down by a flat-head screw gives the required variation in the distance between each successive punching. The thickness of the stock to be punched (¼-inch hard sheet brass) made it desirable to have the stripper plate as rigid as possible. It is held in place by the four studs and nuts as shown.

To prevent shearing on the punch or die, the back end of the punch, *E*, was allowed to enter the die before the actual punching takes place. The strip to be punched having been cut the desired width and slightly beveled on the end, as shown at *D*, was held against the stop disk and fed along in the usual way, care being taken to keep it close up against the gage. When the gage is adjusted to its extreme position the bolster may be swung around to bring the gage in the same relative position with regard to the bed of the press which it occupies in the sketch, thus enabling the operator to feed the strip straight across instead of on an angle.

New York. H. J. BACHMANN.

* * *

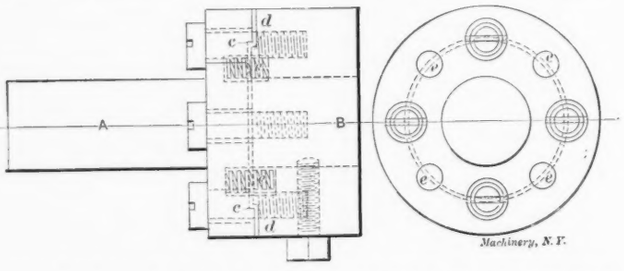
SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP.

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

SELF-ALIGNING HOLDER FOR SCREW MACHINE.

The cut shows a self-aligning holder for a screw machine which has proved very satisfactory in my experience. *A* is the holder shank, and *B* is the holder for the tool. *A* is counterbored at *c*, and *B* is made with a shoulder at *d* to fit loosely in *c*. The difference in size of *c* and *d* depends upon the amount of side movement required. *A* and *B* are held together by four screws which have the same amount of clear-

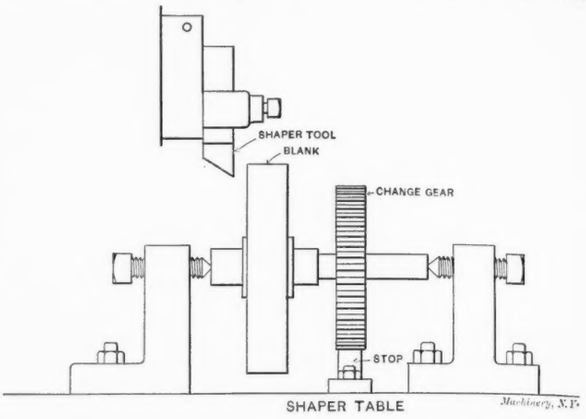


ance in *A* as given at *c-d*. Four holes are drilled at *e* to hold spiral springs, which counterbalance the thrust of the reamer or other tool held in the holder. It will be seen from the construction that no matter in what direction movement is required for alignment, it may be obtained, and at the same time the tool is held from turning.

Roxbury, Mass. C. M. DALL.

SIMPLE GEAR CUTTING DEVICE.

Several years ago I worked in a repair shop which had no universal milling machine or index centers that could be used on the planer or shaper. Consequently we were in pretty bad shape when it came to the matter of making new gears, which fortunately we seldom had to do. When such a job could not be escaped the foreman rigged up the primitive device shown in the sketch, which worked fairly well, although the product would scarcely have passed a critical shop inspector armed with micrometer measuring tools. The device consisted of two angle plates, clamped to a shaper table, and having two holes tapped through the upper ends for the pointed setscrews. These played the part of centers for supporting the mandrel carrying the blank and a lathe change gear having the same number of teeth as were to be cut in the blank. The stop was clamped to the table and fitted closely in the tooth

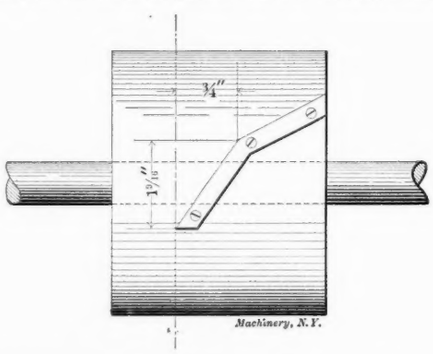


spaces of the change gear. The blank was "indexed" by loosening one of the centers, lifting the change gear out of engagement with the stop and turning it one space. By roughing out the blank and then going over it with a finishing tool a pretty fair gear could be made, but it took a lot of time.

R. E. DERF.

CAMMING SCREW MACHINES FOR THREAD CUTTING.

In the first place I figure the number of revolutions the drum turns per minute. For example, the line shaft makes 180 revolutions per minute and drives from 14-inch pulley to an 8-inch on the countershaft. Applying the usual formula, we have $180 \times 14 \div 8 = 315$ revolutions of the countershaft. A 5.8-inch pulley on the countershaft drives a 12-inch on the wormshaft, which will run 152.2 revolutions per minute. We may drop the fraction. The wormwheel has 150 teeth, which, with a single pitch worm gives: $152 \div 150 = 1\,1\text{-}75$ turn of the drum per minute. The drum is 15 inches in diameter, and its circumference is $15 \times 3.1416 = 47$ inches. In 1 1-75 turn a point on the drum will move $47 \times 1\,1\text{-}75 = 47\frac{5}{8}$ inches, nearly. Then I figure the speed of the stock. For example: A 10-inch pulley on the countershaft at 315



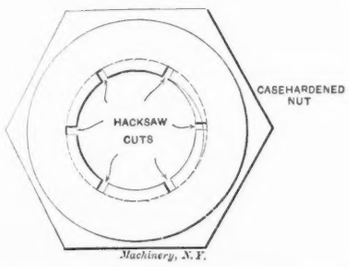
revolutions per minute driving a 7-inch on the spindle of the screw machine, gives $315 \times 10 \div 7 = 450$ revolutions of stock per minute.

Now as we cut one thread for each revolution of the work, if we wish to cut a 20-pitch thread ¾ inch long, it will take $20 \div \frac{3}{4} = 15$ threads $= 15$ turns. Now to find how far the drum will travel for each 15 revolutions of the stock we have: $15 \cdot 450 = 1\text{-}30$ of a turn of the drum, which is $47\frac{5}{8} \div 30 = 1.58$, or .018 inch more than 1 9-16 inches. We must then lay out the cam to give ¾-inch longitudinal motion to the cam roller while the drum rotates a distance equal to 1 9-16 inches, as shown in the accompanying sketch. The cam plate should be made somewhat longer than the exact layout calls for, to allow the roller to pass the heel and engage the angle positively before the tool enters the work. G. H.

Dayton, O.

TO STRAIGHTEN BRUISED THREADS.

A little trick worth knowing in repair work is the use of casehardened nuts for straightening bruised threads. It frequently happens that in dismantling a machine some of the bolt threads are jammed so the nuts cannot be started again when it comes to the matter of assembling. If hand dies are available such threads may be readily repaired, as a general thing, but it sometimes occurs that a bolt or stud is so located that an ordinary hand die cannot be used without removing it, and this may mean a lot of extra work, to say nothing of

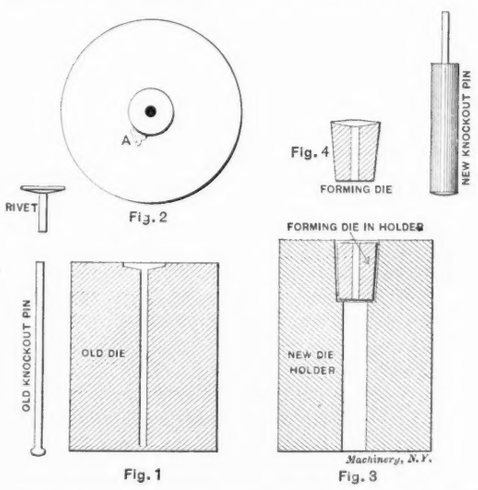


the delay. If the thread is only slightly jammed a casehardened nut of the same size and lead screwed on, will generally correct matters so the regular nut will go on without trouble. If the damage is more serious it may be necessary to convert the nut into an improvised solid die, which can be done with little work. Anneal the nut, and with a hacksaw, working through the nut, cut slots in the thread, as shown in the sketch. Then harden the nut and you have your die. Of course the bruised thread must be filed down so the nut can start, and you must expect it to do but little actual cutting.

R. E. DERF.

A SMALL CHANGE THAT MADE A BIG IMPROVEMENT IN THE OUTPUT OF A MACHINE.

I am toolmaker with a manufacturing company which makes an automatic button requiring a stud or rivet composed of copper, and of the form shown in the cut. These studs were formerly supplied by an eastern firm, and were a big item in the cost of producing the buttons. It was finally decided to purchase a rivet-making machine to manufacture the rivets at home. The first obstacle to overcome was that the maker of the machine was averse to selling one to my firm, claiming that it would never pay, and that we would be unable to find



anyone who could keep the machine in operation. Notwithstanding this discouragement, the machine was purchased at an outlay of something like $1,200. It was then "up to me" to make the machine work and to reduce the cost of the product. We were able to make the machine work successfully, but soon found that the die was an expensive piece to keep in good repair. It was 1½ inches diameter by 1¾ inches long, while the rivet stem diameter was only 0.090 by ¼ inch length, with a head ⅜ inch diameter and 0.017 inch thick. My principal trouble was the uncertainty in tempering the dies. They generally gave trouble by breaking out as shown in Fig. 2 at *A*, after which the die was a total loss. I finally decided to do away with the large die, making a die-holder of the same dimensions as the original die. The die-holder was made of cast steel, tempered, and was ground out to a taper of 0.010 in ½ inch of length, so as to secure a good driving fit for the die. The small forming die was made as shown in Fig. 4 to fit in the holder with its upper face 0.015 below the surface. The knockout hole was enlarged to admit a pin strong enough to knock out a die when one had to be removed. With this construction the die and die-holder are practically one so far as the operation of the machine is concerned, but when the die has to be renewed, I only have to handle a small piece of steel which is hardened and tempered with much less risk than the former large die. The dies are made of drill rod, hardened and ground to fit. The saving in work and material has reduced the cost of production one-third. I have had some of the new dies running eight days of ten hours each, making in all 493 pounds of rivets, or better than the maker's daily production by nearly 200 pounds.

HERMANN G. KROEGER.

Louisville, Ky.

[It seems scarcely fair for our correspondent to assume that the change in the die should be altogether credited with the surprising increase in output, for a solid die should give an equal output so long as it remains in good shape. But the principle is one that can be profitably employed in many places, and in this connection it is worth noting how often the success or failure of a machine depends upon the design of a small part.—EDITOR.]

CIVILIZED, THOUGH SAVAGE.

We have come into possession of the following unique business card of a western machine shop, which speaks for itself. While 'tis said that "music hath charms to soothe e'en the savage breast," no one who knows the feeling can deny that the whir of the emery wheel and the squeak of the planer belt, are more cheering to the traveling journeyman looking

STANLEY SAVAGE O. W. SAVAGE

SAVAGE BROS.

"Civilized" Machinists

824 27TH STREET

Patents Designed and Manufactured.
Electrical Wiring, Commutators Turned.
All Kinds of Tool and Novelty Work.

DENVER, COLO.

for a job than the most entrancing operas ever sung. Where the machine shop exists there is a marker of civilization, although some of the exponents of the trade perhaps are not above certain "butcheries" that savages could not comprehend. Let us hope that the play on the word in this case is not deceitful.

* * *

HOW TO FALL DOWN A CHIMNEY.

A foundryman tells in the Fidelity and Casualty Co.'s *Bulletin* how to fall down a chimney without serious damage. He had directed one of his employees to inspect the inside of the chimney of a cupola furnace. The chimney was 125 feet high. It was so built that the circular aperture was less at the bottom than at the top, gradually narrowing. The employee went to the top of the chimney, and seated himself on a board, suspended by a block and tackle from a cross beam laid over the aperture. He was to be lowered in this way to the bottom of the chimney. Some part of the lashing gave way, and the man fell plumb down the chimney. With rare presence of mind he spread his elbows and knees so as to retard his fall, and finally, after dropping fifty feet, brought himself to a standstill. He was rescued with no further injuries than scraped skin, where he had pressed himself against the narrowing walls of the chimney.

* * *

An obvious error occurred in the February data sheet "Strength of 20-degree Involute Cut Teeth," contributed by Ch. J. Steen. The decimal points were omitted in the upper row of numbers for steel. Instead of reading, 0, 25, 5, 75, 10, 125, they should, of course, read 0, 2.5, 5, 7.5, 10, 12.5, etc.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

The following questions are referred to the readers:

32. F. H. M. Will you kindly inform me what effect, if deleterious, heating malleable iron to a cherry red, would have?

33. J. S. S.—How can I make an adjustable die-holder to hold any size of square pipe die, up to the limit of its capacity, for use in a screw machine? The shank of the holder must fit the holes of turret head which are 1½ inches in diameter, and the holder must be very strongly built on account of the great resistance of pipe dies cutting rough stock. A 1-inch pipe die is 3 inches square, which would be the maximum limit for capacity of holder.

Answer to No. 30.

Editor MACHINERY:

In the following I give replies to questions 2 and 3 asked by H. P. R. in No. 30 of "How and Why" in January MACHINERY. The formulas were given me by a friend, an eye specialist:

A four per cent. solution of cocaine is excellent for removing foreign matter from the eyes. An ounce of this solution will cost about 65 cents, but one must be acquainted with the druggist to get it without an order from a physician. I have used the above strength of solution for six years, with best of results. A medicine dropper should be used, and I have *never* used more than two drops at one time and seldom find more than one necessary. It causes a slight sting when dropped in the eye, and the eye should not be touched until the smarting has stopped, when the subject will not feel anything from the operation. A simple remedy for inflammation in the eye is 10 grains of boracic acid dissolved in one ounce of soft or distilled water. Put 40 grains in a four-ounce bottle, then fill bottle with water. Acid should cost 5 cents. Don't pay a druggist for putting in the water; do it yourself. Bathe inflamed eyes with this solution. ERNEST J. BUCHET.

Dubuque, Iowa.

34. Subscriber.—I wish to repair the plunger of an ammonia pump that has been in use for 14 years. Can you tell me whether the contact with the ammonia for so long a period would affect the qualities of the iron in such a way that it would be necessary to make different allowances for a shrinkage fit, in case it should be necessary to shrink the plunger onto the rod?

A.—We referred this to the De La Vergne Machine Co., manufacturers of refrigerating and ice-making machines, who reply as follows:

In our opinion there should be no objection to this, as in our experience we have never found a case where the iron deteriorated in contact with ammonia, except where the ammonia gases were of a very high temperature, which does not occur in the practice of refrigeration.

35. A. L. P.—What is a crown gear? I noticed an engraving in an engineers' paper some months ago of what I have always supposed to be a bevel gear, but the title or caption of the engraving calls it a crown gear.

A. The illustration to which you refer is a bevel gear; a crown gear has teeth of very narrow face, and is usually cut from sheet metal, the teeth being of the same width throughout their length, which is, as stated, very short. Hence, the resemblance to the conventional crown, and the name. Such gears run with ordinary spur gears, and are only used in light machinery, like clocks, ordinarily, although there are many instances of pin-shaped teeth, which are of this order, having been used in windmills and other old mill machinery transmitting several horse power. An instance was illustrated in MACHINERY, April, 1903, by Prof. Forrest R. Jones.

36. C. W.—In your issue of February, 1902, you illustrated a method of power transmission with loose belts in which a keeper belt was stretched tight over the pulleys on top of the loose belt. Do you consider this arrangement preferable to the one where binder pulleys are employed?

A. In the illustration the upper view shows a loose belt drive connecting an engine band wheel with a jackshaft and the jackshaft with a dynamo. Below is the same arrangement of jackshaft, dynamo, and engine wheel connected by belts having binder pulleys. The main object of the keeper belt, as we remember it, is to keep the belt from flapping and also to keep the belt tight on its driving side when the engine is shut down, so that there will be no jumping in starting up again. The power transmitted by the keeper belt is comparatively small since it is a narrow belt. It is well known, and perhaps has been impressed upon the public largely through the advertisements of a leading maker of belt dressing, that belts properly cared for will transmit all the power they should carry when running loose. A demonstration of this is to be had in cases where binder pulleys are used. The object of the binder pulley should not be so much to keep the

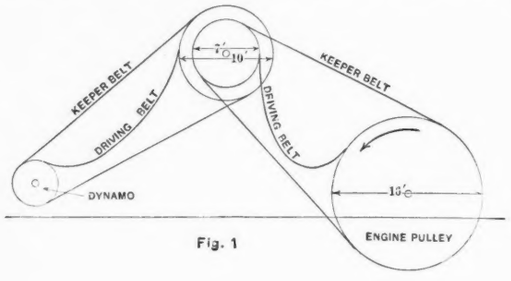


Fig. 1

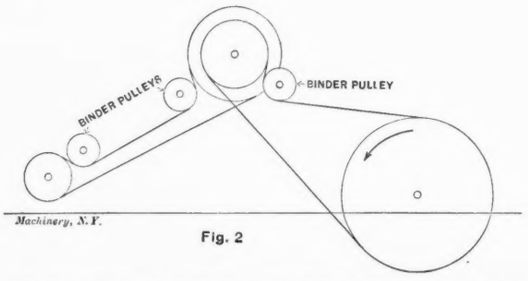


Fig. 2

belt tight as to insure its following the circumference of the pulley through as great an angle as possible. When such belts are running it is possible, if they are in good condition, to slack up on the binder pulleys for brief intervals of time and the belt will continue to follow the surface of the pulley just as it did when the binder pulley was in its original position. This would indicate that the only point of superiority through the use of binder pulleys is, or at least ought to be, that they compel the belt to follow the pulley a little further around its circumference than in the case of the drive shown in the upper part of the sketch where the keeper belt is employed. We believe the binder pulleys will give a little better result than the keeper belt, and should prefer them if it were necessary to get the utmost power possible with a given set of pulleys.

* * *

The *Times* of London has arranged to publish a weekly scientific and engineering supplement which is intended to broadly represent British engineering and science from a national point of view. In the foreword the statement is made that British engineering has not received the public and political support to which it is entitled, considering the importance of engineering to the British nation. While it is admitted that the engineering profession is very well represented by technical publications, it is thought that one of wider scope and greater variety of readers is now needed to give engineering dignity and general standing, hence this unique departure in newspaper publications. The standing of the *Times* and its generally accurate and authoritative statement of affairs is a substantial guarantee of what the character of the new publication will be, and we look for the first issue with much interest.

* * *

The annual general meeting of the Iron and Steel Institute of Great Britain will be held at the Institution of Civil Engineers, May 11 and 12, 1905. The autumn meeting will be held in Sheffield September 25 to 29, 1905.

SHOP RECEIPTS AND FORMULAS.

Practical Tried Receipts—those known to be Good—are Solicited.

TO HEAT THE TIPS OF SMALL TOOLS.

Sometimes it is necessary to heat, for the purpose of hardening or annealing, the tips of small tools, such as counter sinks, etc. To do this without heating other portions of the tool is at times difficult to accomplish. If the tool is inserted into a raw potato, exposing only the part to be heated, the operation is easily performed.

South Portland, Me. J. V. N. CHENEY.

FORMULA FOR CASEHARDENING PREPARATION.

Yellow prussiate of potash, by weight, 7 parts; bichromate of potash, 1 part; common salt, 8 parts; pulverize the crystals and mix thoroughly. Heat the piece to be hardened to a dark red and dip into the preparation or sprinkle it on the piece. Return to the fire and let it soak, then repeat several times according to the depth of hardened surface wanted. Finally plunge into water or oil. This may be used on tool steel, soft steel or iron. JAMES P. HAYES.

Meriden, Conn.

COLORING STEEL.

Having occasion to darken polished spots on casehardened parts in order to make the entire pieces appear uniform, I immersed them for about 20 seconds in a solution made as follows: Eight cubic centimeters of nitric acid and 40 cubic centimeters of water, same being measured by a druggist. The pieces I refer to were casehardened in the usual manner (packed in bone dust). After immersing as above stated, rinse off in clear running water and you will not be able to distinguish the difference between the part which was formerly bright and the dark portion.

Chicago, Ill. HARRY ASH.

TO RECUT OLD FILES.

Dissolve four ounces of saleratus in one quart of water and boil the files in it for half an hour, wash and dry them. Have ready in a glass or stoneware vessel 1 quart of rain water to which 4 ounces of best sulphuric acid have been slowly added, keeping these proportions for any amount used. Immerse the files in this preparation, then wash them clean, dry quickly and cover with a little sweet oil. Coarse files should remain in the diluted sulphuric acid for about 12 hours, though from six to eight hours are enough for fine ones. Files may be recut three times by this process, and the liquors may be used at different times if desired. R. B. CASEY.

Schenectady, N. Y.

SILVER PASTE FOR BRASS.

This paste is used for silvering the scales on thermometers and the dials for clocks, aneroid barometers, steam gages, etc.

Put in an ordinary tea cup or other suitable vessel, 1 ounce of silver—coin silver will do, but pure silver is better and cheaper. Fill the cup half full of nitric acid, and place it in a vessel containing water, which must be heated. As the acid heats, it throws off fumes in shape of a brown smoke, very poisonous. When the smoke ceases to appear, add a teaspoonful of common table salt, and when the fumes caused by this cease, take the cup from the heat immediately and fill slowly to the top with cold water. Allow the white powder that will now be found in the cup to settle to the bottom and then slowly decant the liquid. When almost empty, fill again with cold water, and decant again, repeating this process at least half a dozen times. Mix the powder (commercial chloride of silver will do instead) with 10 pounds table salt, and ½ pound cream of tartar. Mix thoroughly dry, then add enough cold water to make a paste. Add the water slowly so as not to get in too much. Keep in a covered vessel and from the light.

The graduation marks, figures, and letters, stamped or cut into the work may be filled with ordinary roofing tar, which is applied by heating the work enough to melt the tar. Most of the surplus tar may be scraped off with the edge of a card, or any cardboard handy. This filling stands better than sealing wax, and will not dissolve and blur when lacquered if the lacquer is put on properly. Another filling is japan, which is applied with a brush cold, and cleaned with a card as before. It is then baked, and when the work is finished, the filling will be found to be glossy and permanent and will not be dissolved by any lacquer or heat.

The piece to be silvered should be thoroughly cleaned with emery cloth or paper just before applying the paste, which is to be put on by hand and rubbed well in the surface of the work. After this is done, the work should have a dirty, silvery yellow tinge, which will be brightened by rubbing with a dry mixture of ½ pound cream of tartar and 10 pounds salt well mixed. The work should be thoroughly washed to clear it of the surplus salt and then dried in sawdust and lacquered. I have used this method for silvering over 30,000 steam gage and clock dials, and many other dials and scales; hence I know it is all right. J. S. GORDON.

Brooklyn, N. Y.

GRANT'S RECEIPT FOR WHITEWASH.

W. E. G.

No doubt some time or other one of the many readers of MACHINERY has had occasion to whitewash the ceiling or wall of his factory, barn, or other buildings, and wondered what was the best whitewash and how to make it. Possibly he recollects an instance a month, or it may be a year or more, ago, when he whitewashed his shed or fence and used a common whitewash mixture that a neighbor gave him, and after he had put it on and allowed it to become thoroughly dry, doughnuts to dollars it cracked or peeled off. This is particularly the case with common whitewash when applied to the interior of factories or buildings where there is more or less vibration. Noting the condition of his shed, and remembering the time and money he had spent fruitlessly, he resolved to never use whitewash again, paint being good enough for him. Had this whitewash remained where he had placed it and retained its clear snowy whiteness, this same man would have looked on the brighter side of life and been a staunch advocate for whitewash. Nothing looks more cleanly on the interior or exterior of a building, especially an old one, than a nice snowy coat of white paint or whitewash; and whitewash, if of the right kind, is the cheaper and preferable where a large surface has to be covered. A receipt for a good whitewash is generally in demand, and the one that I am about to give you was sent by Gen. U. S. Grant, then President of the United States, to his old friend, Gen. I. Bulson, who was stationed at San Francisco.

Gen. I. Bulson, wishing to whitewash some of the buildings around the barracks and hearing that Gen. Grant had a receipt for a very good whitewash, wrote to him requesting a copy of the same. The following is an exact copy of the letter received a few weeks later:

Brilliant Whitewash.

Washington, Dec. 1, 1871.

Half a bushel unslacked lime; slack with warm water, cover it during the process to keep the steam; strain the liquid through a fine sieve or strainer; add a peck of salt, the same to be previously well dissolved in warm water; add three pounds of ground rice boiled to a thin paste and stir in boiling hot; add one-half pound of glue which has been previously dissolved over a slow fire and add five gallons of hot water to the mixture; stir well and let it stand for a few days, covering up to keep out dirt. It should be put on hot. One pint of the mixture, properly applied, will cover a square yard. Small brushes are best. There is nothing can compare with it for outside or inside work and it retains its brilliancy for many years. Coloring matter may be put in and made of any shade—Spanish brown, yellow ochre, or common clay, etc., Yours truly,

U. S. GRANT.

To my dear friend, I. Bulson,

San Francisco.

P. S.: I whitewashed the White House all over with it.

U. S. G.

MACHINERY AND TOOLS.

A MONTHLY RECORD OF NEW APPLIANCES FOR THE SHOP.

LUNDELL UNIVERSAL MOTOR.

A short time ago an arrangement was made between the National Electric Co., Milwaukee, Wis., successors to the Christensen Engineering Co., and Mr. Robert Lundell, for the National Electric Co. to manufacture and market Mr. Lundell's new line of universal motors. These motors are remarkable for their overload capacity, and in many respects their construction is quite a radical change from the usual practice. Some of the latest patents of Mr. Lundell are for a new type of motor and dynamo frame construction, and a new method of

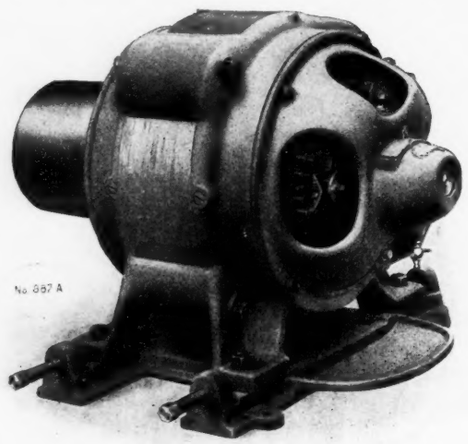


Fig. 1. Lundell Universal Motor.

commutation by which there is a material gain in space occupied, increased efficiency, and considerable flexibility of regulation and speed control.

The general appearance of the new motor is indicated by Fig. 1. The cast-iron frames or housings, which contain the laminated yoke rings, consist of a rigid open casing made in two parts, front and rear, as shown in Fig. 2. The rear part has four hollow extension arms, accurately bored to engage

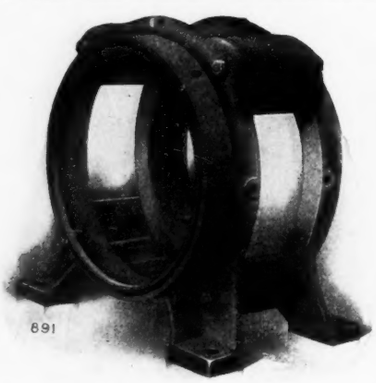


Fig. 2. Frame of Motor.

Fig. 3. The Laminated Yoke.

and support the laminations assembled therein. The front and back frames are secured together by bolts passing through these arms. The frames so connected make a very stiff construction, which is in no way dependent for its stability and the alignment of the machine upon the yoke laminations being in place.

The construction of the laminated yoke is shown by Fig 3. The entire magnetic circuit is made up of laminated mild steel in the yoke, pole pieces, and armature body. These yoke rings are secured and accurately centered in the frame just described. The pole pieces are separately punched from the same material as the yoke rings. They are provided with end plates constructed so as to furnish ventilating ducts to carry off the heat generated in the field coils. Retaining bolts pass through these end plates and the frames, accurately setting the pole pieces, and causing them to make good contact with the inner diameter of the yoke rings as shown in Fig. 4.

It has not been found necessary to introduce ventilation into the center of the armature in machines up to 60 H. P., since the losses have been found to be very low. The armature coils are all form-wound and are separately insulated. The commutator shells are ventilated through their centers. The bars are made of hard-drawn copper insulated by mica. One of the interesting features of the motor is the arrangement of the brushes, which are not, as is customary, placed

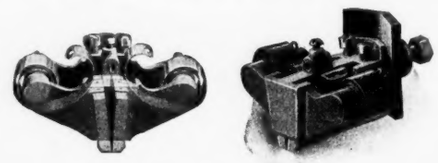


Fig. 5. Brush Holders.

side by side on a stud in a line parallel to the commutator bars, but are placed one directly in front of the other in tandem. The total brush surface is the same as that occupied by the side-by-side brushes, but the advantage is gained that any possible irregularity of the commutator surface strikes only one brush of a stud at a time, so that while one brush may jump, its mate is making contact, and the circuit thus remains closed for that stud, each brush having its independent tension spring. It is stated that this arrangement of the brushes greatly reduces the temperature of the commutator, and greatly aids in obtaining broad ranges of variable speed. Where conditions of service call for special commutating conditions, the brush at the leaving edge is made of high-resistance carbon to take care of the sparking conditions, and the other of high conductivity to carry the current. The brush holders are shown in Fig. 5.

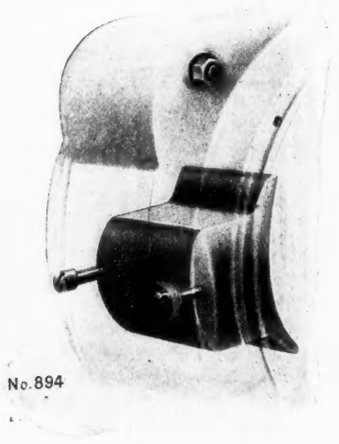


Fig. 4. Pole Piece in Place.

It is stated that the construction of the Lundell motor is particularly advantageous in variable speed motors for direct connection to machinery, and is equally valuable for series parallel control, etc.

A NEW FRICTION BALL BEARING DRILL.

A new sensitive drill just placed on the market by the Francis Reed Co., 43 Hammond Street, Worcester, Mass., (shown on next page) has a number of noteworthy points of construction. It is designed to meet the demand for a light sensitive drill that will handle the new high-speed steels. With this point in view the head is made to slide on the standard by means of the manipulation of the lever, thus giving a special rigidity to the spindle. The spindle has a ball-bearing thrust collar and is provided with a Morse No. 1

taper. Its travel is 10 inches. Stop collars are provided to limit the travel of the head, the lower one having an adjustable screw for more accurately gaging the depth of hole drilled. The head is counterbalanced by an adjustable spring.

The rotation of the spindle is through friction plates, the driven plate being placed above the friction driver, so that the working surfaces are protected from dirt; and, the weight of the friction plate and its shaft being always on the driver, a forced contact by means of a screw is largely unnecessary.

Reed Friction Drill.

For whatever adjustment is thought desirable, however, such a screw is furnished on top of the friction plate shaft. This screw is intended for hand manipulation only, and a wrench should not be used.

The screw presses on a ball-bearing plate with a spring to give a flexible pressure on the friction-plate shaft, which also runs on ball bearings. A speed variation of from 1 to 3 can be obtained by turning a handwheel on the right-hand side of the machine, and thereby altering the working diameter of the friction-plate.

A serviceable feature of the drill is the friction clutch shown at the base. The operator starts the machine by pressing down the lever on the right, while by pressing down the lever on the left side he stops the machine.

The machine occupies little floor space and belts direct to the line shaft, requiring no countershaft. The base of the machine is 20 inches in diameter, the table is 15 inches in diameter and can be adjusted vertically through 27 inches. The greatest distance from the spindle to the table is 32 inches. The steel supporting column is 2 inches in diameter and is solid. The friction plate and friction driver are 10½ and 5 inches in diameter, respectively. The total height of the drill is 72 inches. Its weight is 210 pounds. At a test made with these drills a 9-16-inch drill bored 4 inches through solid cast-iron in 1½ minutes.

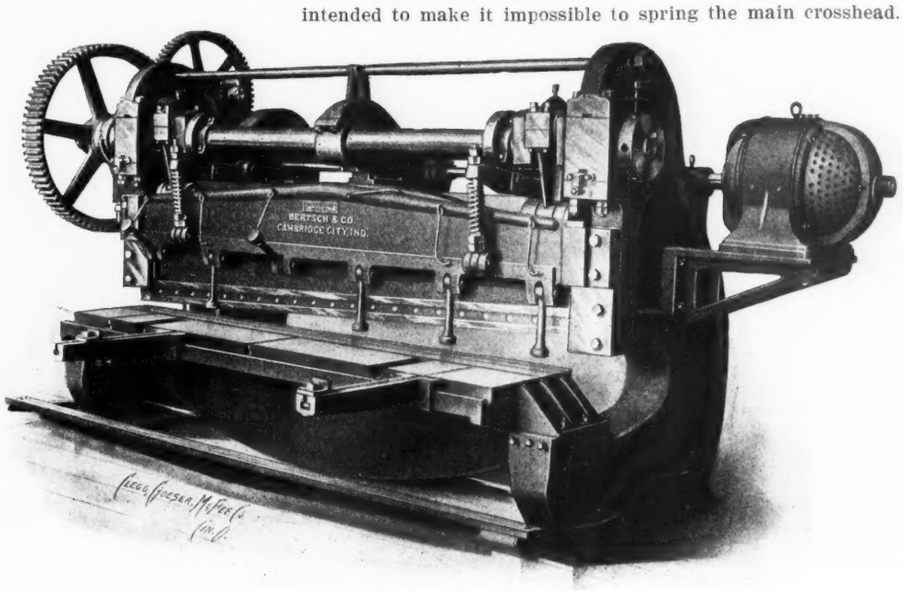
MOTOR-DRIVEN SHEAR.

The accompanying half-tone engraving presents a new shear recently designed by Bertsch & Co., Cambridge City, Ind.

This shear has been designed especially to meet the requirements of rolling mills, where the service is particularly heavy. Such a shear is also necessarily suitable for general shearing in sheet iron shops.

The cut shows the shear built with the makers' patented hold-down device which is actuated by cams on the main driving shaft, and so designed that it is self-adjusting for all thicknesses of metal. In this the pressure legs or gags, and not the solid portion of the hold-down, clamp the sheet; consequently the shearing line can be seen at all times, and further, narrow strips can be sheared conveniently without danger to the operator. These legs or gags can be turned up and locked easily, thus converting the machine into a plain shear without a hold-down, which permits of the top blade being removed and replaced without taking off the hold-down casting.

The shear is also provided with a patented center bearing, which consists in an adjustable wedge fitted between a bearing on the rear of the crosshead and another bearing on the heavy cross-tie casting bolted to the two housings. This is intended to make it impossible to spring the main crosshead.



Motor-driven Shear.

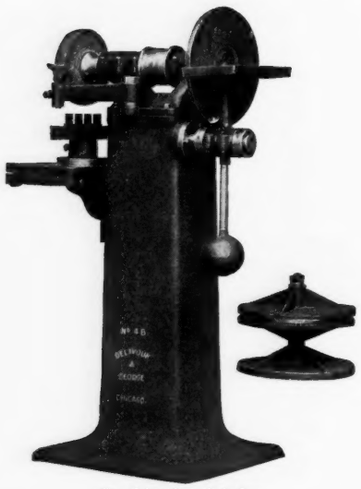
This shear is triple geared, with the gears rigidly supported and self-contained. It has a four-jaw clutch with steel faced jaws, and a cast steel switch ring acting against a steel plunger with a hardened steel roller that is positively controlled.

The crosshead bearings are provided with brass gibs for taking up wear. The crankshaft bearings are made of bronze set in split boxes that are easily adjustable or removable. The crankshaft and main crosshead are easily removable. The shear is furnished with motor, engine or belt drive.

COMBINATION DISK AND DIE GRINDER.

The disk and die grinder shown on next page is a new model recently brought out by Delivouk & George, 122 South Clinton Street, Chicago. The disk seen to the right in the illustration is covered with emery paper or cloth, which may be secured to both sides of the wheel by a quick-drying cement. For this operation the wheel is clamped in a press furnished for this purpose, shown back of the machine. Disks covered with emery paper are stated to be very rapid cutting devices. The table shown to the right has a rocking motion which distributes the motion to the full surface of the disk; it can, however, be clamped rigidly in position or set at any angle from 45 to 90 degrees, which is a valuable feature in some work. This disk is adapted to grinding off rough surfaces on drop forgings, castings, etc., and also to finishing work.

The emery wheel at the left of the machine is useful for ordinary grinding, or for rough grinding before applying the work on the disk. This table is hinged to a bracket on one end, with a screw under the opposite end by which a fine adjustment of feed can be attained. This bracket has a vertical adjustment of 14 inches, is counterbalanced by a weight inside the pedestal, and can be securely fastened to the column by the movement of a cam lever. For the grinding of punches a holder is furnished to receive the shank, as shown in the cut. By its use punches can be easily ground to the same height or sharpened. In place of the emery wheel, a cup wheel or

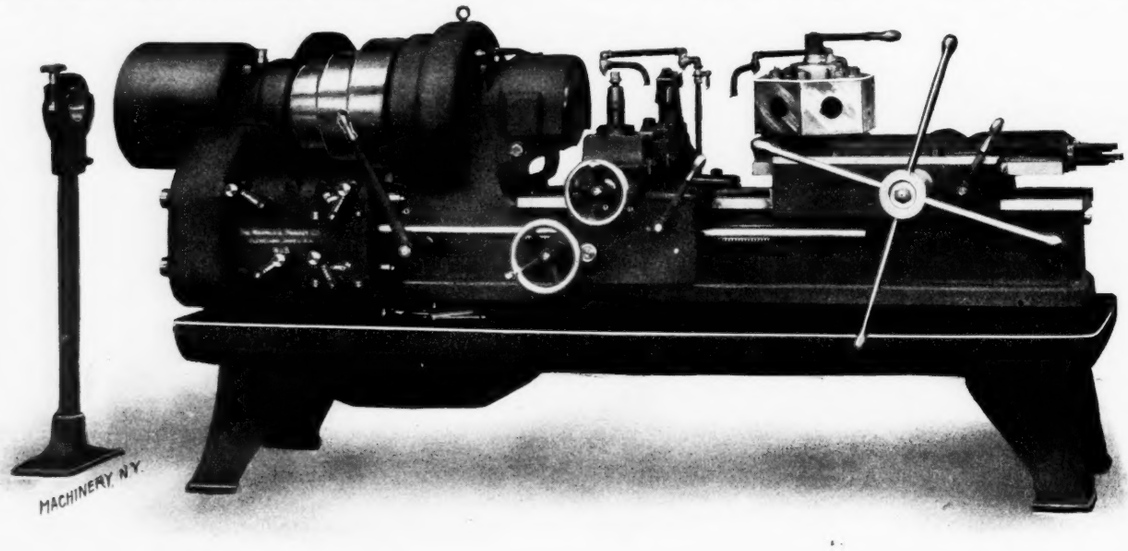


Combination Grinder.

disk can be used if desired. The bearings of the machine are dust proof, and all wearing surfaces are provided with adjustments. Hardened rings are provided for end thrust.

A NEW TURRET SCREW MACHINE.

A turret screw machine of new design which is being brought out by the Warner & Swasey Co., Cleveland, O., is shown in the accompanying cut. This machine has a swing over bed of 20 inches, and takes bar stock up to 3⅝ inches in diameter; the turret slide travels 14 inches. The head and bed are cast in one piece, thus insuring rigidity. The cone has three steps for a 4-inch belt, and is geared 1.85 to 1, and back geared 7.44 to 1, the back gears being engaged and disengaged by friction clutches. Twelve spindle speeds give a range of from 15 to 156 revolutions per minute.



Turret Screw Machine.

Features of the machine are an automatic chuck and the power roller feed. The chuck is operated by the long lever in front of the head, which works through a system of compound levers. The same lever also engages and disengages the roller feed. The chuck jaws are adjustable for variations from actual size to 1-16 smaller.

The turret saddle is provided with a supplementary taper base, by means of which the center of the tool holes of the turret can be adjusted to the exact height of the center of the spindle. Taper gibs extending the whole length of the saddle on each side provide means for adjusting the slide sideways. The turret slide is equipped with geared automatic feed which gives four changes in either direction, from 20 revolutions of spindle to 1 inch feed, to 102 revolutions. The turret is hexagonal and has tool holes 2½ inches in diameter, and also bolt holes for attaching tools to the faces. Stock of any diameter smaller than the tool holes can pass entirely through. The index is nearly the full diameter of the turret, and a lock bolt is placed directly under the working tool. Independent adjustable stops are provided for each face.

The carriage has a geared automatic cross feed with four changes in either direction, from 61 revolutions of the spindle to feed 1 inch, to 306 revolutions, and a hand longitudinal feed. A toolpost for holding forming and turning tools, and a cutting-off tool holder, are provided. Any of the changes of feed is available by shifting a lever in front of the gear box. The turret and carriage feeds are independent of each other, and both are provided with adjustable automatic trips.

A geared pump delivers oil to the cutting tools of both the turret and carriage through two systems of piping, and operates when running in either direction. A double friction countershaft accompanies the machine, arranged for belt drive, but a motor drive can readily be applied.

FORTY-TWO INCH BORING AND TURNING MILL.

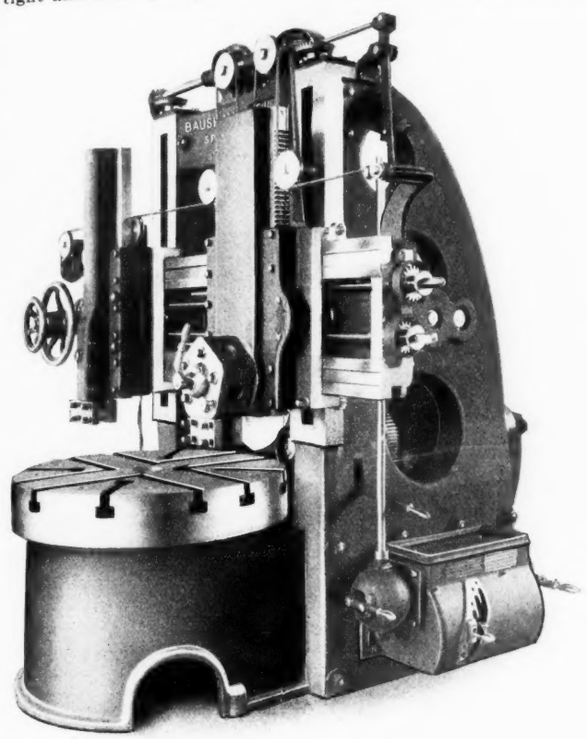
The Baush Machine Tool Co., Springfield, Mass., have designed and put on the market the boring and turning mill accompanying this description. As regularly made this mill has one turret head and one swivel head. Its capacity is work 44 inches in diameter, 37 inches in height under the cross rail, or 31 inches under the tool holder. The table is 42 inches in diameter, is powerfully geared, and has ten changes of speed, five with back gears and five without. This gives a range of table speeds of from 20 revolutions per minute maximum to a minimum speed of 6 revolutions.

The teeth of both the table and pinion are of steel. The table spindle is 10 inches in diameter and 22½ inches in length. It has a straight bearing which acts in conjunction with an angular bearing to receive the side strains. There is also a thrust ball bearing on the lower step of the spindle, which acts as a preventative against any lifting tendency, and relieves the friction of the table when a heavy cut is being taken. On the under side of the table there is an outer bearing nearly equal to the diameter of the base.

The turret slide shown on the right hand in the figure can be set to bore, turn and cut 8 and 11½ threads per inch, and has a vertical movement of 24 inches. The turret has five sides 10 inches across the flats, and has five 2 5-16 inch holes. The heads are entirely independent in their movement, both as to direction and amount of feed. The swivel head on the left can be brought to the center for boring. It as well as the turret head has a vertical movement of 24 inches. The heads are attached to steel feed-screws by split nuts which can be opened and a rapid movement obtained by ratchet and

pinion engaging a steel rack on the cross rail. The feeds are positive and have fifteen changes, ranging from 1-64 inch to 61-64 inch horizontally, and from 1-64 inch to 9-16 inch in angular and vertical directions.

The cross rail can be raised and lowered by power without revolving the table. The back gears can be changed by means of a lever without the use of a lock nut. The countershaft has tight and loose pulleys, the driving pulley being 20 inches in



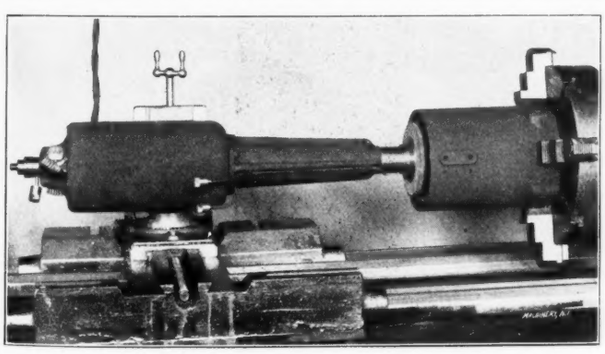
Baush 42-inch Vertical Mill.

diameter for a 4½ inch belt; it should run at 300 revolutions per minute. A band brake operates on the main driving cone by hand. As this machine is self-contained it should not require an elaborate foundation.

NEW MOTOR-DRIVEN INTERNAL GRINDER.

Herewith is illustrated a portable electrical internal grinder. This tool is especially designed for grinding and finishing up gas, steam and air cylinders, grinding out dies, truing up bearings, and for cylindrical grinding of any kind.

The grinder weighs 76 pounds, and the motor will develop about 1 H. P. The minimum size of hole in which this machine



Internal Grinder with Motor Drive.

will grind is 3½ inches. The dimensions of the motor are 6 x 12 inches, and the spindle extends 12 inches.

This grinder is bolted to the toolpost rest of the lathe by means of an angle plate, and has a vertical adjustment to bring it in line with the centers. The driving power is obtained from an ordinary incandescent lamp socket, direct current. This machine is being put on the market by the Hisey-Wolf Machine Co., Cincinnati, O.

FLEXIBLE STEEL-ARMORED HOSE.

The demand for a steam or air hose which could be absolutely relied upon has led the Sprague Electric Company to enter the field with a new product which is felt to meet the requirements, so that the trainmaster, the mechanic or the

Flexible Steel-armored Hose.

quarryman can feel assured that he is safe from serious accident due to defective hose. The new product is known as "flexible steel-armored hose" and consists of a suitable rubber hose encased in a steel armor which prevents expansion and thus greatly increases its life. The armor also protects the hose from mechanical injury and insures flexibility by making it impossible to flatten or kink when handling. In ordinary rubber hose, when over-vulcanization occurs, it bursts and is immediately useless, whereas if a crack should occur through over-vulcanization in the flexible steel-armored hose, the steel armor binds the rupture so tight that very little pressure is lost and the work in progress does not stop. This permits the hose to be used until a new piece can be obtained, and not only saves time, but, in many cases, human lives. In any case it is a money-saver. The accompanying illustration shows the general appearance of the hose. The manufacturers have issued Bulletin No. 50518, describing it, which will be sent upon request by addressing the Sprague Electric Company, 527 West 34th Street, New York City.

PIPE BENDING MACHINE.

Pedrick & Smith, 222 Girard Avenue, Philadelphia, Pa., have just brought out a machine for cold-bending pipe to any desired curvature. The machine is operated by a handwheel which carries a pinion. The latter engaging a quadrant gear operates the bending quadrant. One end of the pipe is held in

Machine for Cold Pipe Bending.

position by a U-shaped clip, while a pin or roller in the platen engages the pipe toward the other end. The placing of the pin or roller in the different holes governs the curvature obtained.

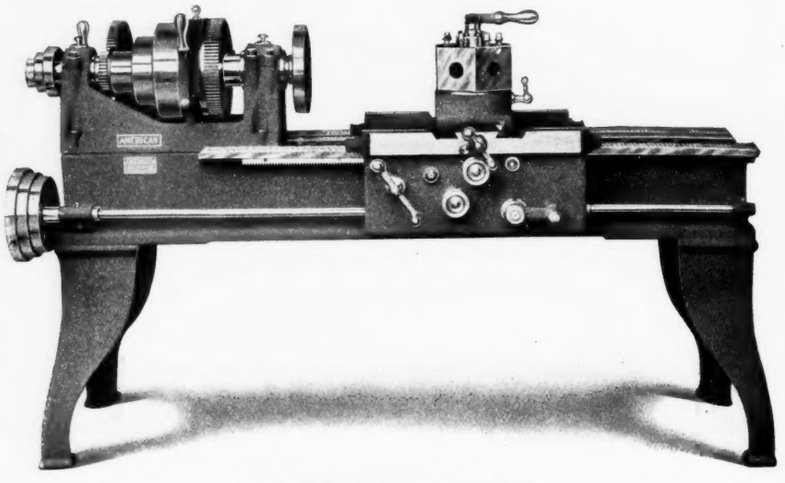
The Pedrick & Smith pipe-bending machine is light in weight, and can be readily carried to the work from the shop, and can be either secured to any available support or mounted on its own stand, as shown in the illustration. It is stated that piping of steel, iron, brass, copper, or other material, can

be bent cold up to 2 inches diameter with the services of but one man. It is also said that where pipes are coated by the Sabin process, or galvanized or tinned, this machine will perform any desired bending operation without breaking the coating in any way.

STERLING GRINDING AND POLISHING MACHINE.

The photograph below is of a new grinding and polishing machine manufactured by the Sterling Emery Wheel Manufacturing Co., Tiffin, O. It is intended for the general servcie to which emery wheels and polishing wheels are put in the foundry and machine shop. It has a spindle 48 inches long,

Grinding and Polishing Machine.



American Manufacturing Turret Lathe.

and is 35 inches high. The bearings are 10 inches long, and 1⅞ inches in diameter; the distance between the flanges is 34 inches. The boxes are self-oiling. Tight and loose pulleys can be placed on the arbor, or a countershaft can be supplied where necessary. The weight of the grinder is 435 pounds.

AMERICAN MANUFACTURING TURRET LATHE.

The American Tool Works Co., Cincinnati, O., have just brought out a new turret lathe which has been designed and built specially for the use of automobile builders, gas engine manufacturers, and others having similar lines of work which require a powerful, rigidly built tool to stand up under the usage of high-speed tool steel. The lathe illustrated herewith has a bed of patent drop V pattern, which gives 2 inches additional swing. The spindle is of high carbon special steel, with a hole of large diameter throughout. The bearings are of phosphor bronze, with means for any necessary adjustment.

The carriage is heavy, especially in the bridge, and has continuous bearings on the ways; it is gibbed to the bed for its entire length. The turret slide has full bearing across the carriage in a wide dovetail; a very long gib is used on this slide. The turret, which is made heavy, is hexagonal, and has no overhang. It is provided with a substantial locking device of tool steel.

There are three feeds, both cross and longitudinal, obtained through a belt-driven feed rod. Friction locking devices are used in the apron. A stop is furnished for properly locating the turret centrally for boring.

This lathe is made in various sizes with either plain back-geared or friction-geared head, belt or geared feed, and with or without a screw cutting feature and other usual engine lathe attachments.

COAL OIL SHOP FORGE.

The Burke Machinery Co., Cleveland, O., have just introduced a coal oil forge for machine shop use in hardening and tempering dies, forging and dressing shop tools, and similar work which is not too large to get into the dome of the forge. The forge, illustrated herewith, consists of a main stand or tank casting, which is built to withstand a test pressure of 100 pounds to the square inch, and which will hold enough coal oil to run the forge for several days. Oil is forced by air pressure on top of the oil through pipes which extend from the bottom of the oil tank to the burners. The burner is a standard hydrocarbon coil burner, equipped with one needle valve and one regulating valve. It is inclosed in a cast-iron case which retains the heat and prevents ill effects from unnecessary draft should the forge be used out of doors. On top of the tank casting is a fire brick dome consisting of five pieces—the dome proper, a plug for filling the hole in the top, a piece to set in the back closing the rear of the forge, an angle plate to set against the front to close the latter after the work has been placed inside, and a small fire brick table to be placed inside the forge when delicate work is to be hardened. When the brick in the top of the dome is removed, a small melting pot can be placed in the top of the forge and used for melting babbitt, lead hardening, etc.

Coal Oil Forge.

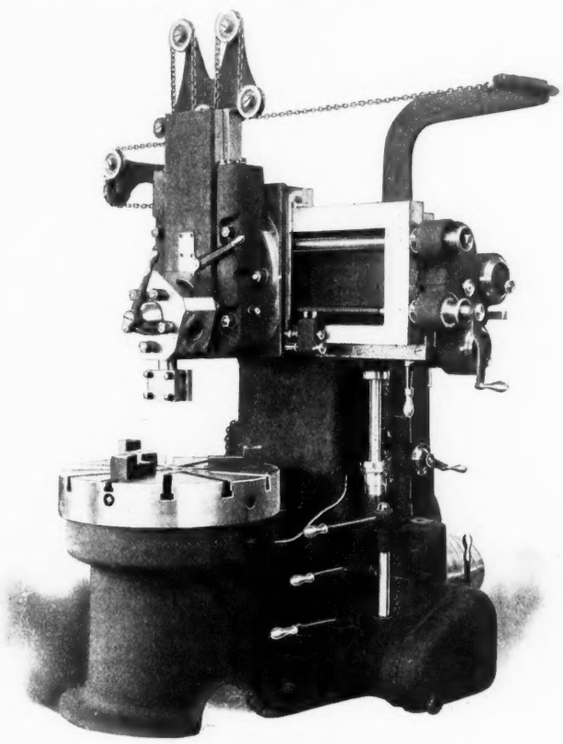
The forge is self-contained and therefore portable. The opening in the dome is 5 inches wide, 4½ inches high, and 8 inches deep. The oil passing through the coil burner is turned to gas which, when blown from the regulating valve, makes

its own mixture with the surrounding air, no blast of air being considered necessary. A cloth filter is placed in the pipe between the burner and the tank to prevent the clogging of the burner by coal oil sediment.

When once pumped up the compressed air upon the oil in the tank casting operates the forge for half a day or more, depending entirely upon the heat required. For ordinary shop work a pressure of from 25 to 30 pounds gives sufficient heat. For melting tool steel 75 pounds pressure is required. For ordinary pressure about 1½ gallons of coal oil for a working day of ten hours are consumed. It is stated that a heat of from 2,200 to 2,500 degrees F., which is requisite for hardening and tempering high-speed tool steels, can easily be obtained with this forge.

GISHOLT VERTICAL MILL.

We show in the accompanying illustration a 34-inch vertical mill which has just been brought out by the Gisholt Machine Co., Madison, Wis. This machine differs from the former vertical mills of this company chiefly in the headstock; in all machines except this the friction back gear headstock has been used, but on the 34-inch there is a four-step cone pulley drive, and back gears are thrown in and out by means of a positive



Gisholt 34-inch Vertical Boring Mill.

clutch operated by a lever. The machine is fitted with feed tripping devices similar to those used on the larger sizes, by means of which any feed may be automatically stopped at any point. The feed screws are all fitted with micrometer index dials, reading to .001 of an inch. The two-speed countershaft provides sixteen table speeds. Eight changes of feed are provided, all of which are operated either by power or by hand. The spindle drive is of the spur pinion variety. As illustrated, the machine has a swivel turret head with a screw cutting attachment, but it may be made with a plain head, and without the attachment.

ANDREW MULTIPLE IRON DRILLING MACHINE.

A new design of multiple iron drill put out by M. L. Andrew & Co., Cincinnati, O., is herewith illustrated as Fig. 1. These machines are built in different sizes, having capacities up to the drilling of fifty holes in steel at one time. The largest machine of this type built by the firm weighs 28,000 pounds and can drill twenty-four 1¼-inch holes in steel at one operation.

Holes of different sizes can be drilled either on a straight line or staggered. Fig. 2 shows the arrangement of the spindles, the cut to the left for straight line work, and that to the right for staggered drilling. The spindles are fitted with long taper and thrust ball bearings; they are bored to suit either straight or Morse taper shank drills. Each spindle is adjustable, and driven by carbonized phosphor-bronze bevel gears.

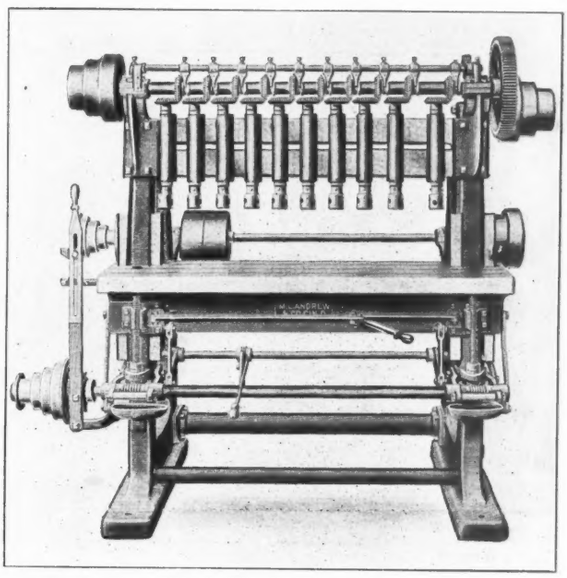


Fig. 1. Andrew Multiple Drill.

The table is counterbalanced and fitted with both hand lever and automatic screw feed. There are provided automatic stops to gage any required depth of holes to be drilled. There are four changes of table feed and a quick return stroke. The main driving shaft is driven from both ends, one end being fitted with a 3-step cone pulley and compound gear for heavy work, while the other end may be driven from a 3-step cone direct, for rapid light work. Each table is provided with rotary pump and tanks for oil or other lubricant.

HANDY COMBINATION MICROMETER.

The micrometer measuring device shown in the cut is an instrument designed and made by Mr. E. G. Smith, Columbia, Pa., principally for use in colleges and engineering schools, for laboratory measurements, but owing to its general adaptability it has been found to have many uses in machine shop and other manufacturing plants. It can be made with a screw

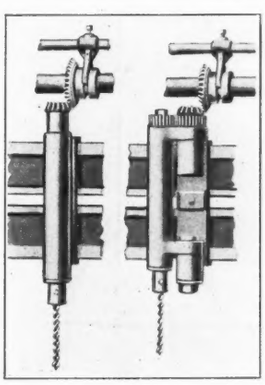
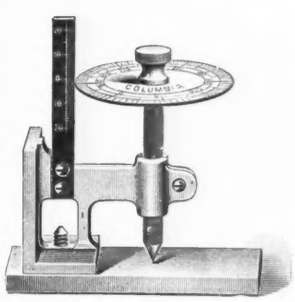


Fig. 2. Arrangement of Spindles, Andrew Drill.



Smith Combination Micrometer.

cut with a thread of 1 millimeter lead, in which case using a disk divided into 100 parts gives readings of 1-100 millimeter; or if the screw is cut 20 threads per inch and a disk with 50 divisions is used, the readings are in 1-1000 inch. It is pointed out by the maker that two of these instruments on a long true surface plate, with the two measuring screws facing each other, make a simple and accurate measuring instrument of

a length limited only by the length of the surface plate, and one that can be constructed at small cost. Such use, of course, would require a set of standard test or measuring bars for setting the heads. It does not appear to us, however, that more than one such head is really essential, since any means for holding a pointed center or other abutment at the required height would serve equally well at one end. This device can also be used for a depth or height gage.

BORING TOOL HOLDER.

The boring tool holder shown in two views, Figs. 1 and 2, is a device recently patented and placed on the market by Carr Bros., Syracuse, N. Y. It consists of a shank and clamp, and

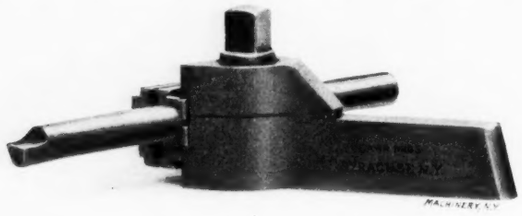


Fig. 1. Boring Tool Holder.

a steel block perforated longitudinally with four holes of varying sizes for the four sizes of round tool steel, ¼, 5-16, ⅜, and ½ inch diameter. The block is dovetailed on four sides to fit the clamp, and is slotted through to each hole so that the clamp can pinch the sides of the block firmly upon the tool.

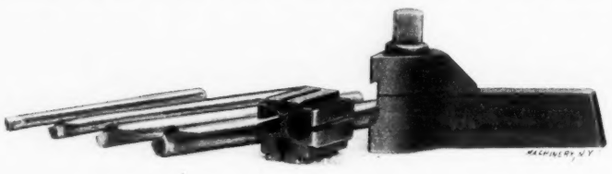


Fig. 2. Parts of Boring Tool Holder.

While the tool is designed for general use, it is particularly adapted to the wants of toolmakers and other workmen who require a large variety of boring tools, which, when forged, are the most expensive lathe tools to make.

EMMERT QUICK-ACTING MACHINISTS' VISE.

The "Presto" quick-acting vise brought out by the Emmert Mfg. Co., Waynesboro, Pa., is shown in the accompanying half-tone, Fig. 1, and in section in Fig. 2. The vise is made

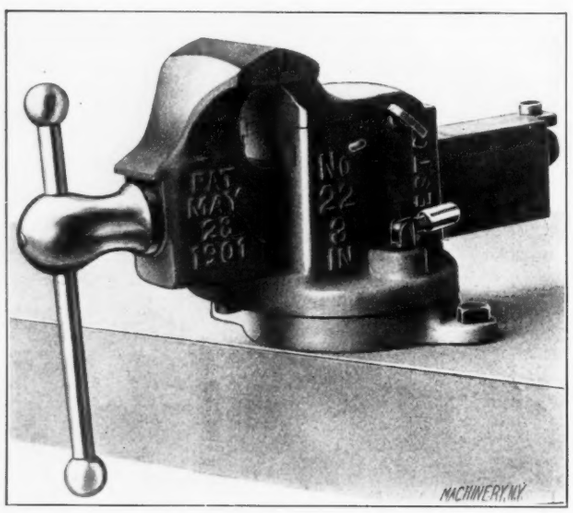


Fig. 1. Emmert Quick-acting Vise.

in all sizes and styles, ranging from 3-inch to 6½-inch jaws. The quick-acting feature may be understood by reference to the sectional view, Fig. 2. The toothed pawl which engages the toothed base rack, both being of steel, is seated in the solid nut block, and is forced into or out of engagement with the rack by the stationary pin, and held in either position without the aid of springs. The quick-acting feature is put into operation by a quarter turn of the handle to the left, when the pin raises the pawl out of engagement, and the workman can immediately set the jaws of the vise to the proper size of

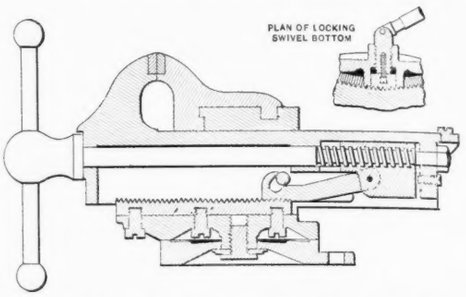


Fig. 2. Sectional View of Vise, showing Quick-acting Movement.

the work. A quarter turn of the handle to the right will then securely hold the work, the first movement of the handle releasing the pawl from the pin, allowing it to drop into engagement with the rack.

* * *

Diesel engines burning crude oil have been running electric generators which operate street cars and electric lights for the Key West Electric Co. for over a year. The internal combustion engine seems to be very applicable in this district on account of the high cost of coal and the comparative cheapness of oil. The fuel costs of the Key West Electric Co. are said to have been reduced from $24,000, when using the steam engines, to less than $6,000 with the oil engines. The old steam plant used 5 pounds of coal per K. W. hour on the average, which cost $5 per ton, whereas the oil engines only use about 7-10 pound of oil per K. W. hour at 3 cents per gallon. The whole plant of this company will shortly be operated by oil engines, and all of the steam engines shut down.

* * *

FRESH FROM THE PRESS.

ELEMENTARY COURSE IN MECHANICAL DRAWING, PART 1. By Arthur W. Chase. 189 pages, 7 x 9, oblong. Illustrated by 95 figures. Published by Howland Speakman, Chicago, Ill. Price $1.50.

In this work Mr. Chase, who is instructor of machine drawing and design in the R. T. Crane Manual Training High School, Chicago, Ill., has outlined the result of several years' experience in placing the subject before manual high school pupils. The object of the work has been to stimulate the thinking qualities of the pupils and to prevent mere copying. All plates required in the course are omitted, as are also time-consuming exercises designed to give skill in the use of instruments only. The student is given a problem from which he must construct the drawing without following any other guide save the printed instructions. A large number of geometrical problems are given as an introduction to the course. In defending this practice the author says that plane geometrical drawing is the foundation of all drawing either for industrial or artistic purposes. It involves the construction and representation of only two dimensions, and therefore is more easily comprehended than three dimension drawings, to which it forms an appropriate stepping stone. Since Part 1 is entirely devoted to principle, it can only be reviewed on this basis, and judging from the thoroughness with which the author endeavors to impress principles, we shall look for Part 2 to give the pupil a better grounding in practical machine delineation than many works on mechanical drawing that have preceded it. The prime consideration for the successful draftsman is the ability to form a mental picture of the device or shape which he is endeavoring to lay out, and this work is compiled in a way that should stimulate this power.

NEW TRADE LITERATURE.

THE GRANT GEAR WORKS, INC., 6 Portlandt St., Boston, Mass. 1905 edition of their catalogue, containing their stock gear list, with prices, and some useful hints on gears, with tables and gear chart.

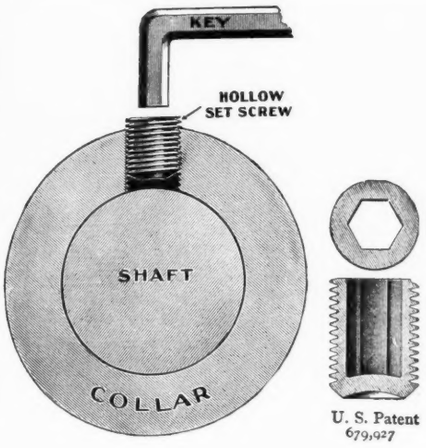
THE WHITMAN & BARNES MFG. CO., Chicago, Ill. Catalogue No. 56 of twist drills, reamers, taps, drop-forged and screw wrenches and cotters. Several sizes and styles of drill cases are shown, and also bit stock drill sets and a price list of the W. & B. warranted files.

F. A. ERRINGTON, 39 Cortlandt St., New York. Catalogue of the Errington automatic-reverse tapping chuck, and leaflet describing an adjustable frictional opening stud setter. An improved duplex self-centering tap holder is now made for the chuck, which permits the tap to automatically align itself independent of the chuck.

THE R. D. NUTTALL CO., Pittsburg, Pa. Catalogue No. 9, January, 1905, of gears and pinions for mine and industrial machinery. Here are shown motor gears, motor pinions, haulage trolleys in great variety, machine gears and pinions, etc. The company expect to issue a very complete catalogue in the near future, their present one showing only some of the types.

THE INGERSOLL-SERGEANT DRILL CO., New York. Catalogue No. 52 of coal mining machinery. Air compressors, coal cutters, coal and rock drills, etc., are shown at work, and descriptions of each of the products appear, accompanied by half-tone illustrations. The catalogue should prove of interest to those having to do with mining machinery.

HAMMACHER, SCHLEMMER & CO., New York. Catalogue No. 262, presenting exclusively bolts, screws, nuts and supplies. This is 5 x 7 in size, bound in cloth, and illustrates and describes a great variety



U. S. Patent 679,927

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The Hollow Set Screw is designed to replace both the headless and square-head set screw and *one length* of each size is all that is required for any depth of hole.

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Short screws do not lose lead of thread as do long ones and hence the new Hollow Set Screws set at once at bottom of hole.

Deep holes need only be threaded at bottom and as far up as diameter of Hollow Set Screw; balance can be counterbored. No shoulder needed on collars and no countersinking, effecting a saving of material and labor.

Hollow Set Screws can be sealed against rust and wet by filling the hole with wax; oil will also prevent rust. Wax makes the screw valuable for use in water on propellers of steamers or yachts, or for similar use.

Protectors and hubs do not have to be cast on revolving shafts and elsewhere to avoid protruding heads which too frequently catch workmen's clothing, causing accidents, as the HOLLOW SCREWS have no projections.

This life-saving feature alone is sufficient to commend Hollow Set Screws for use in preference to all others.

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SOLE AGENTS.

New York City, Since 1848.

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of this class of goods. The catalogue is very attractive in appearance the typography and press work are excellent and the text appears to have been prepared with care, making the booklet useful and reliable in every way.

THE H. W. CALDWELL & SON CO., Chicago, Ill. General catalogue No. 28 of elevating, conveying and power-transmitting machinery. This is standard size, 6 x 9, bound in cloth, and contains 736 pages, 15 of which are devoted to a very complete index. Space will not permit us to enumerate the different products of this firm; we call special attention to their helicoid conveyor, their double-disk friction clutches and the Caldwell-Walker machine molded gears, for all of which they are sole manufacturers, having recently acquired the gear and transmission business of the Walker Mfg. Co., of Cleveland. The book is profusely illustrated.

THE BROWN & SHARPE MFG. CO., Providence, R. I. Illustrated catalogue, 1905, of machine tools and small tools. This is of the usual convenient pocket size, 4 x 6, containing 494 pages. It has been thoroughly revised and new matter added. Our readers are well acquainted with the completeness and thoroughness that characterized previous editions; this one appears to have been gotten out with the same care, and besides the many tools listed, for which there is a very complete index, there are a large number of tables and other general information, making the book very useful for reference. A colored insert calls attention to quite a number of new machines and tools that have been added to their line during the past year. The catalogue will be mailed free to any address or can be procured from hardware and supply dealers.

MANUFACTURERS' NOTES.

THE OESTERLEIN MACHINE CO., Cincinnati, O., are now in their new factory at 2850-2852 Spring Grove Ave.

THE HISEY-WOLF MACHINE CO., Cincinnati, O., have removed from Elm St. to 2850-2852 Spring Grove Ave.

M. L. ANDREW, formerly at W. Second St., Cincinnati, O., has removed to 2850-2852 Spring Grove Ave.

THE MEADVILLE VISE CO., Meadville, Pa., manufacturers of the Barrett horizontal cylinder boring machines and vises, have changed their name to the Barrett Machine Tool Co.

THE FAIRBANKS CO., Baltimore, Md., report the loss by fire on Feb. 17 of all their catalogue files and price lists, and will be glad if all manufacturers of machinery and supplies, etc., will send to them at once copies of their catalogues and discount sheets.

MORSE, WILLIAMS & CO., Philadelphia, Pa., with branch offices at Boston, New York, Baltimore and Atlanta, have opened an office at 1018 Penn Ave., Pittsburg, for the sale and erection of all classes of freight and passenger elevators. This company has thirty years' experience and a record of 17,000 elevators sold.

THE MORSE CHAIN CO., Trumansburg, N. Y., are to erect, in the spring, a new plant consisting of machine shop, forge shop, hardening and tempering shop, wood shop, pattern storage, foundry and offices. The machine shop equipment will be modern in every respect, with individual and group drives from 110-volt motors.

MR. ARTHUR KAYSER, Alte Jacobstr. 24, Berlin, S. W. Germany, who for a number of years has been selling agent for F. A. Errington's tapping device in Germany, is visiting this country and would like to hear from manufacturers of small tools and appliances who desire to be represented in Germany. He may be addressed until March 15th in care of F. A. Errington, 39 Cortlandt St., New York.

PAWLING & HARNISCHFEGER, Milwaukee, Wis. Bulletin No. 16, January, 1905, of traveling electric hoists. Twelve different types are here shown and described. Some are of the one-motor and some of the two-motor type, with open or closed cage, and built for many and various purposes. A number of half-tone views show them in operation in various large industrial plants.

THE GEOMETRIC DRILL CO., New Haven, Conn., being organized under a charter granted by the State of Delaware, which was limited in its duration, decided to reorganize as a Connecticut corporation, with a capital of $100,000, under an arrangement whereby the stock of the new company was to be issued for the property of the old, and stockholders of the old company were to receive stock of the new, in proportion to their respective holdings. The transfer has already been made, the new company assuming the obligations of the old.

THE engraving and steel stamp business of the Schwerdtle Stamp Co., and the rubber stamp business of the Bridgeport Stamp Co., have been incorporated under the laws of the State of Connecticut and will hereafter be known as the Schwerdtle Stamp Co., 39-41 Cannon St., Bridgeport, Conn. It is this company's intention to carry a full line of hand stamps, office and factory supplies, and their new factory is equipped with every facility for handling their increasing business promptly and satisfactorily.

THE CORRUGATED GRINDING WHEEL CO., Philadelphia, Pa. Pocket size folder, descriptive of a new form of grinding wheel having slanting corrugations or teeth which make the wheel's action that of shearing rather than grinding. The manufacturers claim a considerable increase in the capacity of such a wheel. A view is shown of a cast-iron test plate, one part of which was ground by an ordinary wheel and another part by the same wheel after being corrugated. The first grinding required 30 minutes for a depth of 1½ inches; the corrugated wheel ground to a depth of 3 inches in the same time.

MISCELLANEOUS.

Advertisements in this column, 25 cents a line, ten words to a line. The money should be sent with the order.

A MACHINIST WANTED in every shop to sell my Calipers and Levels. Liberal proposition. Address E. G. SMITH, Columbia, Pa.

A NEW DEPARTURE.—The Cleveland Automatic Machine Co. of Cleveland, O., appreciating the extensive demand for competent operators, have established a free employment bureau and are soliciting the name and address of all competent non-employed operators, and in securing them they hope to not only very materially assist the operator, but also assist those who may employ them.

ARE YOU SATISFIED with your present position and salary? If not, write us for plan and booklet. We have openings for managers, secretaries, advertising men, salesmen, bookkeepers, etc., paying from $1,000 to $10,000 a year. High grade exclusively. HAPGOODS (Inc.), Suite 511, 309 Broadway, New York.

"DIES AND DIE MAKING."—A practical book, $1.00. Send for index sheet. J. L. LUCAS, Bridgeport, Conn.

DRAFTSMEN AND MACHINISTS—I can obtain good patents for inventions, if you will follow my advice; 20 years' practice; registered; low charges; highest references. EDWIN GUTHRIE, Corcoran Building, Washington, D. C.

DRAFTSMAN'S scales, drafting tables, parallel rules that can be applied to any drafting board. Circulars. Address WILLIAM PILTON, Hamilton, O.

DRAFTSMAN WANTED.—A first-class man on jig, tool and fixture work by reliable manufacturing house. Good place for satisfactory party. Address L. B. MFG. CO., care MACHINERY, 66 West Broadway, New York.

ENERGETIC HUSTLER.—Gentleman thirty-seven years, college man and Shriner. Well equipped offices in prominent downtown building. Desires to represent firm, machinery preferred. Extended acquaintance in New England. Highest possible references. Make our office your New York headquarters. Address CORPORATION, Lock box 1589, New York City.

EXPERIENCED mechanical draftsman wanted at once at Steel Works in Eastern Pennsylvania. Address MECHANICAL, care MACHINERY, 66 West Broadway, New York.

FOR SALE OR EXCHANGE for mechanical books, 4 volumes I. C. S. Shop Practice; good as new; make offer. Address ALFRED HALL, 203 Livingston St., Grand Rapids, Mich.

FOR SALE.—Modern Machine Shop Building for sale cheap, on easy terms or lease. This factory property is located on the Central Railroad of N. J., at Greenville Station, Jersey City, 16 minutes from Liberty St. Ferry, New York. The ground is 100 ft. by 200 ft. and has a railroad siding into the building. The building is modern, brick and structural steel, with 80 ft. cross section, 40 ft. erecting space and two 20-foot bays on each side. Electric crane runway 27 ft. high and supports 20 tons. Whiting foundry, 8-ton electric crane, 30-H.P. engine, 50-H.P. boiler, 20 K. W. C. & C. generator for operating crane and electric lights. Tool-room all fitted with bins and shelving. Small pattern shop and separate stock room enclosed with wire netting. Building 60 ft. long. Temporary frame end to allow for extension. Offices fitted with ash and ground glass. Private office, bookkeepers and general office, drafting room, lavatories, etc. Best class of machinist help living near factory. Apply GREENVILLE COAL & ICE CO., 96 Garfield Ave., or on property at Greenville Station.

FOR SALE.—A very desirable machine and repair shop, residence, location and business; manufacture wood-sawing machinery, which is in great demand; more business than can attend to; want to retire; a bargain. IRVING FOX, Rochester, Minn.

MACHINISTS.—50-page book. Pointers and Rules, etc., full as a nut, try it. 25 cents, stamps accepted. WM. POWLES, 693 Otsego Street, St. Paul, Minn.

MACHINISTS' TABLE of Standard Steam, Gas, Water Pipe, Pipe Fittings, and Tapping Sizes. 5 cents. Stamps. E. E. MEYER, Allegheny, Pa.

PATENTS.—Send for "The Value in a Patent." SPEAR, MIDDLETON, DONALDSON & SPEAR, 1003 F Street, Washington, D. C.

PATENTS.—H. W. T. Jenner, patent attorney and mechanical expert, 608 F Street, Washington, D. C. Established 1883. I make an examination free of charge and report if a patent can be had and exactly how much it will cost. Send for circular. Member of Patent Law Association.

PULLEY CASTINGS.—Machine molded; also finished pulleys. The CENTRAL FOUNDRY CO., Hamilton, O.

SALESMAN WANTED.—For territory west of Chicago, to introduce and sell "Sterling" Hack Saw Blades and Frames to machine shops and hardware trade. No application will be entertained without references, and it is necessary to state age, experience, where last employed. Apply to DIAMOND SAW & STAMPING WORKS, Buffalo, N. Y.

SITUATION WANTED on machine tools and jigs. Experienced designer desires to make a change. Address DESIGNER, care MACHINERY, 66 West Broadway, New York.

SPUR GEAR CUTTING a specialty, from 3 to 48 pitch. Work guaranteed and prices right. Tell us your wants. Address CENTRAL MCH. & TOOL CO., LTD., Battle Creek, Mich.

THAT IDEA you have in mind, let me know and I will develop and make it practical. I make a specialty of this business, also designing of machinery devices, shop equipment, complete drawings made and all work guaranteed correct. Send for estimates. Strictly confidential. Address EDWARD LINDMUELLER, Williamson Building, Cleveland, O.

WANTED.—Factory superintendent for the construction of heavy motor freight vehicles. Must have experience. Address "H.," care MACHINERY, 66 West Broadway, New York.

WANTED.—Machinery salesman, engineers, draftsmen, foremen, superintendents for good positions. Write for terms. CLEVELAND ENGINEERING AGENCY, Rose Building, Cleveland, Ohio.

WANTED.—Agents, machinists, tool makers, increase your salary. Sell Saunders' enlarged Hand Book for Practical Mechanics. A pocket-manual guaranteed to fill the bill as a ready reference and to contain more rules, shop kinks, than all the other mechanical books bound together in one volume. Secrets, from note books of best mechanics in the country, will figure out by simple arithmetic problems you run up against every day in the shop. Price, postpaid, $1.00 in cloth, $1.25 in leather with flap. Agents make big profits. Send for list of books. E. H. SAUNDERS, 216 Purchase Street, Boston, Mass.

WANTED.—Experienced, live salesmen to sell store and street gasoline lighting plants, producing 1,000 C.P., costs 10 cents a day. Liberal salary or commission. Address NATIONAL STAMPING & ELEC. WKS., Chicago, Ill.

WANTED.—Good vise and floor hands. Those familiar with printing press work preferred. Address CAMPBELL P. P. & MFG. CO., Taunton, Mass.

WANTED.—An experienced salesman acquainted with general machinery and machine tools, to travel principally in the Eastern and New England States. State experience and particulars. Address "D. D.," care MACHINERY, 66 West Broadway, New York.

WOULD like to secure copies of MACHINERY data sheets, Nos. 1 to 11. What is the price? Address "W," care MACHINERY, 66 West Broadway, New York.

YOU want machines and parts manufactured. We have a magnificent equipment and will build machines or parts for you. Location, western New York. Address MACHINE TOOL CO., care MACHINERY, 66 West Broadway, New York.